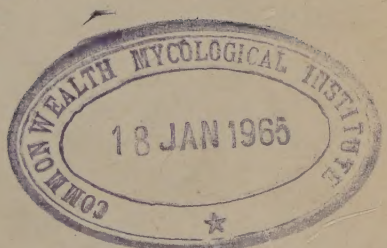
COMMONWEALTH MYCOLOGICAL INSTITUTE
18 JAN 1965

The British Mycological Society.

(Recognosce notum, ignotum inspice.)

(ESTABLISHED 1896).

TRANSACTIONS

1896-1901.

VOL. I.

EDITED BY CARLETON REA.

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25. Massee Mrs. George, 1, Kent Road, Kew, Surrey.
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46. Wager Mr. Harold, F.L.S., Bank View, Chapel-Allerton, Leeds.
47. Ward Professor H. Marshall, M.A., F.R.S., F.L.S., University Botanical Laboratory, Cambridge.
48. Weiss Professor F. E., F.R.S., Owen's College, Manchester.
49. White Mr. J. Hill, F.R.H.S., 54, Broad Street, Worcester.
50. Woolhope Naturalists' Field Club.

Officers for the Season 1896-1897.

President - - George Massee, F.L.S., Royal Herbarium, Kew.

Hon. Treasurer - Charles Crossland, Halifax.

Hon. Secretary - Carleton Rea, B.C.L., M.A., 34, Foregate Street, Worcester.

RULES.

Society's name and objects.

1. The Society shall be called "The British Mycological Society" and its objects shall be the study of Mycology in all its branches, systematic, morphological and pathological, the publication of annual reports recording all recent discoveries in any branch of mycology, and more especially giving a brief synopsis of the work of European Mycologists and the recent additions to the British Fungus Flora.

Members of Society.

2. The Society shall consist of Foundation Members, Honorary Members and Ordinary Members, the number of Foundation Members shall be limited to 100 and that of Honorary Members to 20, but the number of Ordinary Members shall be unlimited.

Foundation Members.

3. Foundation Members shall consist of those Members and Clubs who joined the Society previous to the limit of 100 Members of the Society having been attained, but after this number has been attained no Person or Club shall be admitted as a Foundation Member.

Honorary Members.

4. Honorary Members shall be Ladies or Gentlemen of pre-eminence in Mycology, or who have rendered special service to the Society.

Ordinary Members.

5. Ordinary Members shall be Ladies or Gentlemen elected as hereinafter set out.

Election of Members.

6. Until the limit of 100 Foundation Members be reached any person or Club may signify their desire of joining the British Mycological Society and will consequently be enrolled as Members thereof by the Secretary. Honorary Members shall only be elected at a meeting of The British Mycological Society by the majority of the Members then present. Ordinary Members shall be elected either by the majority of the Members then present at the annual meeting, or meetings, or by the President, Treasurer and Hon. Secretary at other times. All Ordinary Members shall be proposed and seconded respectively by existing Members, who shall sign a certificate (see appendix) in recommendation of him or her, one at least of the proposers so certifying from personal knowledge, and every candidate for election shall sign an undertaking to abide by the Rules if elected (see appendix).

Yearly Subscription.

7. All Ordinary Members shall pay an annual subscription of 10/- and Foundation Members 5/-, whilst Honorary Members shall be exempt from either entrance fee or annual subscription.

Government of the Society.

8. The management of the British Mycological Society shall be vested in the President, Treasurer and Hon. Secretary.

Election of Officers.

9. The President, Treasurer and Hon. Secretary, shall be elected annually, at the first meeting of the British Mycological Society in each year, by a majority of the Members then present.

Meetings or Forays.

10. The British Mycological Society shall hold one or more meetings annually at a place and time determined by the Members at the previous meeting, or in default thereof, by the President, Treasurer and Secretary. Invitations from Local Societies shall be first entertained and the acceptance of such shall imply that the Local Society undertakes to arrange the excursions of the foray, obtain necessary permissions from landowners, and place at the disposal of the British Mycological Society a room

for the exhibition of specimens, delivery of addresses, and the transaction of business.

Accounts to be annually furnished and vouched.

11. At the first meeting of the British Mycological Society in each year the Hon. Secretary shall produce an account of the receipts and disbursements for the previous year duly vouched by the Hon. Treasurer, or if the two offices be combined, then by an independent Member of the Society.

Payment of Expenses.

12. At each Meeting the Members then present must pay to the Hon. Secretary their share of the expenses incurred.

Election of Chairman in absence of President.

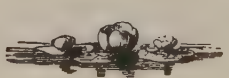
13. In the absence of the President the Members present at any meeting shall elect a Chairman for that Meeting.

Rarities to be recorded

14. Members finding rare specimens, or specimens new to the British Fungus Flora, are requested to immediately communicate the fact to the Hon. Secretary, together with full descriptions, the locality where gathered, and the date thereof, and the Hon. Secretary shall report the same at the next meeting of the Club.

EveryMember to have a copy of these Rules and any alteration thereof.

15. A printed copy of these Rules shall be sent to every Member of the Club on election, and to all Members on their alteration.



APPENDIX.

Form of proposal for Ordinary Membership of the British Mycological Society.

_____

of _____

_____

being desirous of becoming an Ordinary Member of the British Mycological Society, we, the undersigned Members of the Society, certify that we consider h to be a desirable Member of the Society and beg to recommend h for election.

Dated this day of 189

_____(From personal knowledge).

_____

Certificate to be signed by the Candidate.

I hereby certify that I desire to become an Ordinary Member of the British Mycological Society and that I will abide by the Rules if elected.

_____

SHERWOOD FOREST FORAY.

WELBECK, THORESBY, CLUMBER AND THE BIRKLANDS,

13th-18th September, 1897.

The first annual week's fungus foray was held in Sherwood Forest, Worksop being selected as a convenient centre from which the different portions of the Forest could be worked. On Monday, the 13th of September the members assembled at Worksop, where the Lion Hotel was constituted the headquarters, and there a room was set apart for the exhibition of fungi and the reading of papers.

Tuesday, the 14th of September, was devoted to an exploration of the woods on the Welbeck Estate, but owing to the recent drought that had apparently reigned for some time past, but few interesting fungi were collected, though *Tubulina cylindrica*, Rost, was very abundant on some saw-dust, and *Peziza sepiatra*, Cke, was found on a charcoal heap. From thence the walk was continued through various plantations till at last the remnants of the "Seven Sisters Oak" were reached, and the members were fortunate enough to obtain a sight of the white deer herd in the adjoining park.

In the evening, Mr. George Massee, F.R.M.S., F.L.S., delivered his presidential address on "Mycological progress during the past sixty years," a résumé of which appears hereafter. Mr. George Massee, F.R.M.S., F.L.S., was unanimously re-elected President, and Mr. Carleton Rea, B.C.L., M.A., Hon. Secretary and Treasurer, the then present Treasurer, Mr. Charles Crossland, advocating the combination of these two offices in one, as their division only entailed useless expenditure of the Club's funds. The Secretary then read a letter from Professor Johnson, on behalf of the Dublin Naturalists' Field Club, cordially inviting the British Mycological Society to visit Ireland next year under the auspices of their Club; this

invitation was unanimously accepted and the date* was subsequently to be so fixed as neither to clash with the British Association Meetings or with the Cryptogamic Society of Scotland. A hearty vote of thanks was unanimously accorded to Mr. George Massee for his very excellent and instructive address, and for the assistance he had given the Society during his year of office. The Hon. Sec. then brought before the notice of the members the curious way their Society had been treated by the Nottingham Naturalists' Society, which in the spring of the year, in response to a letter from him informing them of our intention of visiting Sherwood Forest, offered to assist us to the very utmost of their powers, but when the time arrived, had done nothing whatever to assist our Society. Mr. Carleton Rea then exhibited drawings by Miss E. A. Rose, of a *Coprinus* new to science, which he had named *C. roseotinctus*, by reason of its being characterized by the presence of deep rose coloured meal on pileus and stem. A full description of which will be found amongst the record of fungi new to Britain. Mr. E. Salmon exhibited a fine example of *Sparassis crispa* Fr., from Surrey, which was subsequently photographed by our member Mr. A. Clarke, and rumour says finally demolished by some ardent mycophagists at breakfast at the Lion Hotel.

On Wednesday, the 15th of September, the demesne of Thoresby was explored under the able conductorship of our member Professor J. W. Carr, M.A., of Nottingham University College, who met the Members at Budby. He first conducted the members into a low-lying damp moist wood known as Budby Carr. There microscopic fungi were found in abundance, and a considerable time was spent in exploring it, so that it was somewhat late before the members proceeded to explore the home park of Thoresby, but the following were noted on the way: *Armillaria mucida* Schrad., *Clitocybe decastes* Fr., *Entoloma majale* Fr., and *Leptonia serrulata* Fr. During the evening Dr. C. B. Plowright, of King's Lynn arrived, bringing specimens of *Lepiota polysticta* Berk., and *Geaster mammosus* Chev.

On Thursday, the 16th of September, the woods of Clumber were visited. This was an ideal day, the members being allowed to wander at their own free will through the Clumber estate, but unfortunately the drought before referred to militated against a good bag, and though the members worked diligently only the following are worthy of notice, namely: *Leptonia chloropolia* Fr., *Clitocybe incilis* Fr., the so-called *Clitocybe Sadleri* Berk. (stated by some authors to be a sterile condition of *Hypholoma fasciculare* Huds.), and *Collybia vertirugis* Cke. In the evening rules for the future regulation of the Society were passed, the limit as to foundation members, from 50 to 100 being only carried by the casting vote of the

* Monday to Saturday, 19th to 24th September, 1898. C. Rea.

President. Dr. Plowright then gave a short résumé of new species of the Uredineæ and Ustilagineae found during the past year, and exhibited specimens of *Urocystis Filipendulae*, Tul. from Mr. Tatum of Salisbury, and of the two species of Barley-smut, *Ustilago Hordei* and *Jenseni*. He pointed out in regard to these two latter, that until recently they had been taken as one species both by agriculturalists and mycologists, but recent investigation had shown that they were very distinct, the one was pulverulent and disappeared before harvest, leaving only a bare rachis, whereas the other was a malignant parasite present in the ears of corn, which not only made the sample dark and therefore of less value, but also if sown without a previous remedial dressing, ensured in the next year a diseased crop; this he ventured to think was of great consequence to the farmer. Mr. A. Clarke then read his promised paper on "Photography as applied to Mycology," illustrated by many splendid photographs of various species of fungi, and all present were agreed that no abler exponent of that side of mycology could have been found to set forth the advantages of such a reproductive process, and especial appreciation was expressed for his magnificent stereoscopic examples.

On Friday, the 17th of September, a long drive from Worksop brought the members to their trysting place, where their guide, Professor J. W. Carr, who somewhat impatient at waiting for the members at the appointed spot, met them shortly after they descended from the carriages. Under his kind conductorship a pleasant ramble was taken to the heart of the Birklands, which at the present day is the sole remnant of the ancient Forest of Sherwood. On the way *Amanita recutita* Fr. was found in some abundance, and the older trees, now living wrecks, were noted as being specially the habitat of *Polyporus sulphureus*, Fr., the condition of which Dr. Plowright attributed to this fungus, but other members not imbued with Hartig's views, thought that age and not that parasite were responsible for their condition. The members then reached the "Butchers' Shambles Oak" or "Robin Hood's Larder," and many interesting forms of fungi were here noted, amongst which we may enumerate a lovely group of *Pholiota adiposa*, Fr., and numerous examples of *Collybia vertirugis*, Cke. At the shooting box the carriages met the members, and thus terminated a most enjoyable week's ramble in search of fungi. In the evening, a hearty vote of thanks was accorded to the Dukes of Portland and Newcastle and Earl Manvers, for the kind permissions that had been granted for visiting their estates. Over three hundred species were gathered during this foray, but as the majority were common ones, only the most interesting are enumerated in the subjoined list.

LIST OF THE MORE UNCOMMON FUNGI AND MYXOGASTRES OBSERVED IN SHERWOOD FOREST, 14-17 SEPT., 1897.

Where no note is mentioned the species were noticed universally, otherwise

B=Birklands, C=Clumber, T=Thoresby and W=Welbeck.

Amanita recutita Fr., C. & B. fide Dr. C. B. Plowright and C. Rea.
Lepiota prominens Viv., W. & B.
metulaespora B. & Br., C.
felina Pers., W. & C.
charcharias Pers., B.
Armillaria mucida Schrad., T. & B.
Tricholoma panaeolum Fr.
melaleucum Pers.
Clitocybe decastes Fr., T.
incilis Fr., T. & C.
Sadleri Berk.
Collybia vertirugis Cke., C. & B.
Mycena iris Berk., C., fide Dr. C. B. Plowright.
Pluteus cervinus Schaeff var eximius Smith., W. & C.
var patricius Schulz., W. & B.
Entoloma majale Fr., T.
costatum Fr.
Leptonia serrulata Fr., T.
chloropolia Fr., C.
Pholiota adiposa Fr., B.
aurivella Batsch., W.
Flammula picrea Fr.
Naucoria badipes Pers.
escharoides Fr., T.
Agaricus xanthodermus Genev.

Hypholoma hydrophilum B.
Psathyra semivestita B and Br., C.
Cortinarius (Telamonia) flexipes Pers.
(Hydrocybe) obtusus Fr.
Lactarius aurantiacus Fl. Dan., T.
Russula rosacea Fr.
nitida Pers.
var cuprea Krom.
puellaris Fr.
Boletus crassus Mass.
castaneus Bull.
Fomes connatus Fr., W. and B.
Trametes serpens Fr.
Merulius molluscus Fr., T.
Porothelium Stevensoni B. & Br., C.
Solenia anomala Fr.
Hydnum viride Fr., B.
Caldesiella ferruginosa Sacc., C. & B.
Thelephora terrestris Ehrh., C. & B.
Lycoperdon excipuliforme Scop.
perlatum Pers.
Ptychogaster albus Fr.
Peziza sepiatra Cke.
Onygena equina P., W.
Tubulina cylindrica Rost.
Trichia fragilis Rost.
varia Rost.
Craterium confusum Mass.
Ceratiomyxa mucida Schröt = Ceratium hydnoides A. & S.

Résumé of the President's Address.

IT would be far beyond my grasp, even if time allowed, to enumerate, however briefly, the rapid progress that has been made in every direction in the study of Mycology during the past sixty years. It would not, perhaps, be stating too much to say that the entire amount of knowledge dealing with Fungi *as living organisms*, that we possess at the present day, has been acquired within that period. Among the pioneers in this branch of the study of Mycology the names of Berkeley, the brothers Tulasne, De Bary, and Brefeld stand pre-eminent. The two first named soon recognised that many among the numerous forms of fungi, previously considered as entities, were not so in reality, but were in many instances only phases in the life-cycle of a single species. Their method of endeavouring to prove the correctness of this new idea was by contiguity, or the constant sequence of forms having organic continuity; a condition of things now proved to be correct in many ascigerous fungi. As would be expected, in breaking new ground, slips were made; those minute fungi that in many instances are almost constantly present as parasites on certain other fungi, proved great stumbling-blocks. The next step, which in point of importance has no equal, was the introduction of the pure-culture method by De Bary. By this method the spores of a given fungus can be grown in a sterilised nutrient medium, and its gradual development followed step by step. Finally, Brefeld's brilliant discoveries are the outcome of a further development of De Bary's culture methods.

The following notes indicate very briefly some of the most important points elucidated by the above mentioned authors.

The Rev. Miles Joseph Berkeley, M.A., F.R.S., produced in 1836 his first work on Mycology (Eng. Flor., vol. v., pt. ii.), which so far as the larger fungi are concerned, is as yet unequalled for accuracy, simplicity of style, and originality; and although he continued to elucidate the systematic side of Mycology, as amply testified by his

magnificent herbarium, containing nearly 12,000 species, of which over 5,000 are type specimens, now deposited in the Kew Herbarium; it is probable that his name will, in the future, be more associated with the morphological and physiological side of Mycology than as a systematist.

The existence of basidia had been demonstrated before Berkeley's time, but in an important paper, entitled, "On the fructification of the Pileate and Clavate tribes of Hymenomycetous Fungi" (Ann. Nat. Hist., vol. 1, 1838), Berkeley was the first to clearly indicate that basidia, usually bearing four spores, were universal throughout the group. At this date the fructification of the Gasteromycetes was entirely unknown, save through some investigations made by Berkeley, which were communicated to Montagne, the celebrated French Cryptogamist. The latter, quick to appreciate their true value, translated Berkeley's correspondence, and it appeared under the title, "Sur la fructification des genres Lycoperdon, Phallus, et de quelques autres genres voisins" (Ann. Sci. Nat., Sept. 1839).

In this paper, accompanied by excellent figures, Berkeley demonstrated the fact that basidia, bearing the spores, are equally characteristic of Hymenomycetes and Gasteromycetes, and thus established the natural group entitled Basidiomycetes. Next appeared a very important paper, entitled, "Observations, Botanical and Physiological on the Potato murrain" (Journ. Hort. Soc., I., p. 9, 1846). Berkeley was for some time editor of the Journal of the Horticultural Society, and during this period numerous important papers on plant diseases emanated from his pen. This especial phase of Mycology was continued in after years in the pages of "The Gardeners' Chronicle," where scores of brilliant articles on plant diseases caused by fungi testify to his thorough grasp of the subject, and secure for Berkeley the great honour of being the founder of the important science known to-day as Vegetable Pathology. In conclusion, Berkeley's "Introduction to Cryptogamic Botany" (1857), although superseded at the present day, contains numerous suggestive paragraphs, which are much more frequently utilised than acknowledgments would indicate by writers at the present day.

Louis-René Tulasne, a member of the staff of the Natural History Museum, Paris, was a Mycologist of whom the French are justly proud. The following papers, selected at random from amongst numerous important contributions extending over a quarter of a century, suffice to indicate the calibre of mind possessed by the author. "Sur l'organisation et le mode de fructification des champignons de la tribes des Nidulariées" (Ann. Sci. Nat., 1844). This paper illustrates clearly for the first time the structure of the members consti-

tuting this interesting group. The author's brother, Dr. C. Tulasne, drew the very beautiful figures illustrating the paper. "Memoire sur l'ergot des glumacées" (Ann. Sci. Nat., 1853). The true life-history of ergot is worked out in detail; the minute conidia present on the surface of the sclerotium, previously considered as an independent fungus called *Sphacelia*, are shown to be merely the conidial or summer fruit of the ergot, the more highly evolved or ascigerous condition being produced from the sclerotium after a period of rest. Their last and most pretentious work, "Selecta Fungorum Carpologia" (1861-1865), in three volumes, folio, is illustrated by 61 plates, which, for exquisite beauty and detail and accuracy, have never been equalled. These volumes are entirely occupied with a detailed account of the morphology and life-history of the various groups of ascigerous fungi. The peculiar structures, termed pycnidia, spermogonia, conidia, &c., previously considered as independent species, were shown to be mere stages in the development of ascigerous forms. The remarkably interesting genus *Hypomyces* was worked out in great detail, the conidial stage of the species being in most cases indicated; such forms having previously been considered as independent species belonging to the Hyphomycetes.

Among the numerous brilliant discoveries made by Dr. Anton de Bary, each one of which would have placed any other individual in the front rank of Mycologists, it is not difficult to indicate the particular one which has led to the greatest results, namely, the introduction of the method of following the life-history of individuals by means of pure cultures. In 1864, De Bary commenced a series of beautifully illustrated monographs under the title "Beiträge zur Morphologie und Physiologie der Pilze," which were issued at intervals until 1882. In each of these new ground is broken, dealing with such subjects as the formation of the sporocarp in ascigerous fungi, and more especially with the sexual mode of reproduction in the Saprolegnieæ, Peronosporeæ, and Perisporiaceæ. The latter idea was elaborated in detail in the destructive parasite called *Sphærotheca Castagnei*, and although mercilessly assailed by Brefeld and others, has quite recently been corroborated in all essentials by Harper (Ber. Deutsch. Bot. Gesellsch., 1895). The discovery of Metoecism or Heteroecism in the Uredines swept away at one blow the numberless so-called species of *Aecidium* and *Uredo*, at the same time clearly indicating the method by which these form-genera could be relegated with their true affinities. In this country Dr. C. B. Plowright was the first to accept and work at the life-history of the Uredines from the standpoint of heteroecism, and I well remember the Friesian School of Mycologists, at the celebrated Woolhope Forays, expressing their deep regret at one of their number daring to depart from the beaten track of attempting—usually in vain—to make their spoils

agree with pictures and too brief descriptions. Finally, such names as Woronin, Karsten, Marshall Ward, Farlow, and Brefeld testify to De Bary's influence and success as a teacher.

Dr. Oskar Brefeld, who worked for some time under De Bary, has laboured continuously for the past quarter of a century in elucidating the life history of the fungi. Among his earliest investigations are those classic monographs on *Mucor mucedo* and *Penicillium*, where it it demonstrated that these are conidial forms alternating with morphologically higher spore bearing structures. The reproductive bodies of the conidial phase, in these and numerous similar instances, are produced in immense numbers, and in rapid succession, and are capable of germinating the moment they are mature, and serve the purpose of enabling the fungus to extend its area during the period favourable for its growth. This process of reproduction explains the rapidity with which fungous diseases spread after having once gained a foothold, especially where the host plant occurs in profusion, as in the case of cereals and other cultivated plants. On the other hand, the spores produced by the higher stage of the fungus require a period of rest before they are capable of germinating, and hence, tide the fungus over that period when conditions are not favourable for active growth.

In like manner numerous typical forms of every group of fungi were examined.

Brefeld's success in inducing spore-germination, and in growing pure cultures for long periods, thus demonstrating the varied forms assumed during different stages of development of the same species, has led to nothing short of a complete revolution of all previous ideas of affinity and classification. In the Basidiomycetes, where previous to Brefeld's researches conidial forms were considered to be very rare, these conditions are shown to abound. The peculiar spore-like bodies on the pileus of species of *Nyctalis*, previously considered as parasites belonging to a genus called *Asterophora*, were proved to be secondary reproductive bodies belonging to *Nyctalis*. The peculiar structures constituting the genus *Ptychogaster*, were in like manner proved to be the conidial forms of species of *Polyporus*. Perhaps the most brilliant of Brefeld's discoveries are embodied in his papers devoted to the life-history of members of the Ustilagineæ, which in addition to their great value as scientific contributions, are also of immense importance from an economic standpoint. Brefeld's researches are contained in twelve volumes, illustrated by numerous beautiful plates, commenced in 1872, under the title "Botanische untersuchungen über Schimmelpilze." In conclusion, it may be

stated that Brefeld denies the existence of a sexual mode of reproduction in the fungi, and is merciless in his attacks on all authors entertaining such an idea.

In England, only one person, Professor Marshall Ward, F.R.S., has consistently worked at Mycology along the lines I have endeavoured to indicate. During his residence in Ceylon, the life-history and morphology of *Hemileia vastatrix*, the terrible Coffee disease, were elaborated; and since his return to this country several very important works have appeared, including the classic entitled, "A Lily Disease," which exhibits an insight and grasp of the subject rarely equalled. Now that Professor Marshall Ward is located at Cambridge, the growth of a British school of Mycology is simply a matter of time.

BRITISH MYCOLOGY.

Under this heading it is proposed, in the first instance, to give descriptions of fungi added to the British list, since the cessation of the publication of "Grevillea." A start in this direction is now made, but space prevents the incorporation of all species recorded since the date above indicated. This list will be continued next year, and the co-operation of all Mycologists is solicited for the purpose of furnishing a complete record. In addition, notes relating to subjects dealing with the work of British Mycologists will find a place.

Lepiota leucothites Vitt., *Fung. Mang.* 310, pl. 40. Pileus globose, then expanding until almost plane, more or less umbonate, glabrous and silky at first, becoming broken up into squamules, especially near the margin, during expansion, white, sometimes with a tinge of brown or ochraceous at the disc, 5-10 cm. across; flesh rather thick, white, unchangeable. Gills free, but rather close to the stem, crowded, thin, rather broad, often wavy, white at first, becoming pale pink with age. Spores elliptical, smooth, hyaline, $9 \times 7\mu$. Stem, 7-12 cm. long, base bulbous, subcylindrical above, 1·5-2 cm. thick, differentiated from the flesh of the pileus, hollow, glabrous, white; ring large, white, persistent, superior.

On the ground. Herbarium Grounds, Kew; Isleworth, Surrey (G.M.); Malvern Hills (Rea).

Probably not uncommon, but hitherto confounded with *Lepiota holosericea* and *L. naucina*, from which it is readily distinguished by the rosy colour of the gills, this colour appearing deepest the day after collection. The figure in Cooke's Illustrations, pl. 524, called *Agaricus* (*Psalliota*) *cretaceus*, Fr., belongs to the present species.

Lepiota prominens Fries, Fr. Hym. Eur. 30 (= *Agaricus porrigens*, Viviani, Fung. Ital. pl. 12). Pileus globose then expanded, umbo large and subacute, disc covered with imbricated scales, the remainder

with scattered, adnate patches or scales of a brownish-ochre, surface between the scales paler, 6-10 cm. across; flesh rather thick, white, not changing colour when broken. Gills white, remote, narrowed behind, rather crowded, thin. Stem 10-18 cm. long, about 1 cm. thick, cylindrical from an abruptly bulbous base, slightly tinged brown or ochraceous, with a few scattered, darker adnate patches or squamules, white and glabrous above the superior, free ring, fistulose. Spores 10 × 7-8μ.

On the ground, Littlehampton (G.M.); Ledbury (Rea).

Closely allied to *Lepiota procera*, but distinguished by the very prominent subacute umbo, the pale stem with scattered patches of a darker colour, and the smaller spores. In *L. procera* the stem is brown with crowded, concentric, whitish cracks, caused by the rupture of the brown cuticle, which becomes rigid before the stem ceases to increase in length, and is consequently cracked in an irregularly concentric manner.

Omphalia Luffii Massee (sp. nov.). Pileus at first convex and more or less undulate, becoming depressed at the centre, extreme margin usually upturned, old ivory colour, white when dry, even, glabrous, 2-3 cm. across, flesh very thin, white; gills crowded, decurrent, thin, 2 mm. broad, pale wood colour, unchangeable; spores elliptical, hyaline, smooth, 5 × 3μ; stem 2-3 cm. long, 2 mm. thick at the base, thickened at the apex, often crooked, solid, outside glabrous, polished, coloured like the gills. Smell fragrant, spicy.

On the ground, gregarious. Guernsey (Luff).

Smell spicy, resembling that of *Clitocybe fragrans*, to which the present plant bears a superficial resemblance, but is readily distinguished by the short cartilaginous polished stem and other features noted above.

Clitopilus Sarnicus Massee (sp. nov.) Gregarious; pileus campanulate then expanding until quite plane, subumbonate, often more or less depressed round the umbo, slightly striate when moist, even when dry, mouse-colour, paler with a ruddy tinge when dry, minutely silky-flocculose, 2-3 cm. across; flesh very thin. Gills rather crowded, 3-4 mm. broad, plane nearly up to the stem, then suddenly decurrent, pinkish salmon-colour. Spores nodulose, with an apiculus, 7-8 × 6μ; cystidia absent. Stem 2-3 cm. long, 2 mm. thick, equal, slightly flexuous, even, white, glabrous, minutely, fistulose.

On the ground among grass. Guernsey (Marquand).

Allied to *Clitopilus undatus*, but differing in the slender, equal, white stem, and the absence of a grey tinge in the gills.

Pholiota sphaleromorpha Bull, Fr. Hym. Eur. 217, Sacc., Syll. vi., n. 3,057. Pileus convex then expanded, becoming plane or slightly depressed, margin often slightly wavy, even, yellow, 5-8 cm. across; flesh whitish, thickish at the disc, and becoming thin towards the margin. Gills slightly arcuately decurrent, rather broad, crowded, dry, pale dingy yellow, then yellowish-brown; spores obliquely elliptical, smooth, pale yellowish-brown, 10 × 7μ; cystidia subcylindrical. Stem 5-8 cm. long, about 2 cm. thick at the base, thinner upwards, stuffed, silky, coloured like the pileus below the distant, white ring, whitish above, flesh tawny.

On the ground. Queen's Cottage Grounds, Kew (Nicholson).

With somewhat the habit of *Pholiota præcox*, but altogether stouter, and with a yellow pileus and stem.

Hebeloma strophosum Fries, Fr. Hym. Eur. 240, *Sacc.*, Syll. vi., n. 3,320. Pileus convex then plane, with more or less of a suggestion of an umbo, rather viscid, bay, margin white and silky from the veil, 2-3 cm. across. Gills adnexed, eventually becoming almost free, crowded, ventricose, flesh colour then dingy cinnamon. Spores elliptic-oblong, smooth, pale cinnamon, 8-9 × 5μ, Stem 3-5 cm. long, 3 mm. thick, about equal, usually curved at the base, hollow, silky, whitish, tinged brown near the base, furnished with an imperfect, white, silky ring very near the apex.

On naked soil. Kew Gardens (Nicholson).

The only *Hebeloma* in which the partial veil forms a ring on the stem. This character at first sight suggests the genus *Flammula*, but the viscid pileus with a silky margin, along with other features, prove the plant to be a true *Hebeloma* belonging to the section *Indusiati*.

Agaricus rusiophyllus Lasch, Fr. Hym. Eur. 282. Pileus rather fleshy, convex then plane, slightly umbonate, fibrillose, pale flesh-colour, becoming pallid, 2-3 cm. broad; flesh whitish, unchangeable. Gill free, but not far distant from the stem, crowded, thin, dry, rosy then brownish. Spores obliquely elliptical, smooth, translucent brown with a purple tinge, 5 × 3μ. Stem 3-4 cm. long, 3-4 mm. thick at the incrassated base, thinner upwards, silky fibrillose, white, imperfectly hollow; ring persistent, drooping.

On the ground. Kew Gardens (G.M.)

A very beautiful little fungus, not closely allied to any other British species, most closely approaching *Agaricus comptulus* in size.

Stropharia æruginosa Curt. var. *squamulosa Massee.* (nov. var.) Pileus subglobose then expanded and slightly depressed, margin drooping, not at all umbonate, dry and silky from the first, soon becoming broken up into adpressed, silky scales, very deep verdigris-green, margin whitish, disc becoming ochraceous with age, 4-6 cm. across; flesh rather thin, white. Gills crowded, ventricose, thin, dry, sinuately adnate, brown, no tinge of purple, rather broad. Spores pale brown, elliptic-oblong, obliquely apiculate, 8-9 × 5μ. Stem 5-7 cm. long, 2 cm. thick, slightly constricted at the apex, hollow when old, paler green than the pileus, base white, flesh also tinged green, fibrillosely striate, clothed with white patches of the broken-up ring near the apex; fragments of the veil also frequently fringe the margin of the pileus.

On the ground among stones, &c. Ripon, Yorks. (Pratt); Louth, Linc., two seasons in succession (Larder); Kew.

A very distinct variety, will probably prove to be a good species; differing from *S. æruginosa* in the perfectly dry, silky, squamulose pileus, stout stem, and absence of purple tinge in the gills.

Coprinus roseotinctus Rea. (sp. nov.) Pileus membranaceus, at first cylindrical, 7-11 × 5-7 mm. fuscous, densely powdered with rose-coloured meal, silky, striate; at length revolute, umbonate, margin torn, sulcate along the back of the gills. Gills white, then black, adnexed, 1-1·5 mm. broad, deliquescent; cystidia not observed. Spores black, pip-shaped, slightly apiculate, 9-11 × 5-6μ. Stem at first short, then elongated, 5 cm. high, 2-3 mm. thick, base bulbous and white floccose, when young densely powdered with deep rose-coloured meal, only sparingly powdered near the apex at maturity, hollow from the first.

On the ground. Temple Laughern, Worcester, 8/97.

Characterised by the deep rose-coloured meal on the pileus and stem. Allied to *Coprinus niveus.*

Polystictus tomentosus Fries, Fr. Hym. Eur. 530. *Sacc.*, Syll. vi., n. 5535. Pileus plane, corky, becoming hard, often variously lobed and irregular, narrowed below into a short, stout, stemlike base, more or less triangular in section, solid, margin thin, straight; surface persistently tomentose or minutely velvety, tawny, margin sometimes yellowish, not zoned, 4-8 cm. across. Flesh pale tawny. Pores very minute, 4-5 mm. × 1 mm., mouth quite entire, rounded, greyish-yellow, at first delicately whitish pruinose. Spores elliptical, pale brown, 5 × 3μ.

On the ground. Guernsey (Marquand).

A very distinct species, allied to *Polystictus perennis*, but much stouter, and without a distinct stem; sometimes extending equally on every side from a central point, solid, pileus flat and not at all depressed; at other times spreading on the ground as an irregularly lobed body, from a central or excentric stout, stemlike, short base.

Bertia collapsa Rom., Bot. Notiser, 178, 1892. Perithecia usually densely gregarious, although sometimes scattered; seated on a brownish subiculum formed of branched, septate, intricately interwoven hyphæ about 6μ thick, obconic, upper surface slightly convex, densely but very minutely warted, with a central papilla, black, opaque, about $\frac{3}{4}$ mm. diameter, when old collapsing and becoming strongly concave above. Asci clavate, apex rounded, wall thin, 40-60 × 10-12μ; spores irregularly 2-3-seriate, elliptic-oblong, hyaline, smooth, 1-septate, 10-15 × 4-5μ. Paraphyses absent.

On dead stems of *Ribes rubra* and *R. Grossularia.* Guernsey (Marquand).

Forming dense black patches on the wood and bark. Hitherto only recorded from Sweden, where it grew on bark of *Pyrus Aucuparia.*

Verticillium Marquandii Massee. (sp. nov.) Patches broadly effused, minutely velvety, pale lilac at first, becoming deep lilac or amethyst coloured at maturity. Vegetative mycelium creeping, branched, septate, hyaline, slender, giving origin to numerous slender, erect, fertile branches, which are either simple, or usually with 1-4 short, alternate, or opposite branchlets, rarely in whorls of 3; tips of branchlets, also tip of main axis bearing a whorl of 3-6 flask-shaped conidiophores. Spores smooth, hyaline, lemon-shaped, solitary on the tips of the conidiophores, or rarely in chains of 2 conidia, 3-3·5 × 1·5-2μ.

Parasitic on the gills of *Hygrophorus virgineus.* Guernsey (Marquand). Common.

A very beautiful mould, and very conspicuous on account of its clear lilac colour. Numerous specimens were received during the months of October and November, 1897.

NOTES.

Professor Marshall Wards' opening address in Section K of the British Association, should be carefully studied by Mycological students, as amongst other subjects, it contains a summary, in chronological sequence, of the important discoveries that have raised the study of Mycology to the high standard it presents at the present day. The address is contained in "*Nature*," Sept. 9 and Sept. 16, 1897.

The "*Kew Bulletin*" for April, 1897, contains under the title, "Mycologic Flora of the Royal Gardens, Kew," an account of the fungi that have been collected in the grounds. These amount to 1,340 species, included in 337 genera. Some of these have certainly been introduced, as for instance *Aseröe rubra*, *Chitonia rubriceps*, &c. On the other hand, truly indigenous species are also abundant; in the genus *Russula*, fifty-two, out of the sixty-one British species, have occurred in the gardens. Probably no other known area of equal dimensions—300 acres—has been shown to produce such a rich Mycologic Flora, even after the forty introduced species are deducted.

Little or nothing is recorded up to the present respecting the Mycology of the Channel Islands. During the past season, thanks to the intervention of Mr. E. D. Marquand, numerous consignments of Fungi have been forwarded to Kew for determination, from Guernsey. Over 500 species have been determined, several of which are new to Britain, and three, *Clitopilus Sarnicus*, Mass., *Verticillium Marquandii*, Mass., and *Omphalia Luffii*, Mass., are new to science. The preponderance of species belonging to the genus *Hygrophorus* is remarkable, and the Channel Islands must be considered as a new area, rich in species, and interesting as forming a link between the Mycologic Floras of England and France.

The form-species, *Botrytis Douglasii*, Tubeuf, must be added to the British list of destructive fungus parasites, young specimens of *Sequoia gigantea*, killed by this fungus, having been received at Kew for examination.

NOTES ON FOREIGN MYCOLOGICAL WORK.

Kawaschin has announced the interesting discovery (*Bot. Centralbl.* xliii, iii, 290) that the so-called microspores of species of *Sphagnum* are in reality the spores of a parasitic fungus developed in the capsules of the moss. This fungus is called *Tilletia Sphagni;* the spores are globose, clear brown, and covered with ridges combined to form a network of polygonal meshes; 11-12μ diameter. Careful search would probably result in adding this interesting fungus to the British Flora. It is said to be most frequent in species belonging to the *squarrosum* group of *Sphagnum.*

Révision des Champignons, *tant supérieurs qu' inférieurs, trouves jusqu'à ce jour dans Les Pays-Bas.* Dr. C. A. J. A. Oudemans.

The second part of this book is now before the public, and is undoubtedly, taken as a whole, by far the most important systematic work on Mycology that has appeared during recent times. The specific diagnoses are original and full, and the notes so frequently supplementing the specific diagnoses are of great value. Part I. (1893), contains the Hyménomycètes, Gasteromycètes, and Hypodermées. Part II. (1897), contains the Phycomycètes, and the Pyrenomycètes.

Monograph of the Laboulbeniaceae.

Dr. Rowland Thaxter has produced under the above title (*Mem. Amer. Acad.* XII., No. iii.), a charming volume illustrated by 26 plates, dealing with a branch of Mycology of which he may be truly said to be the founder, since the allied forms known previous to Dr. Thaxter's researches were very few in number, and imperfectly

understood. The Members of the Laboulbeniaceae are very minute, ascigerous fungi parasitic on insects. "When examined *in situ* on the host insect, they appear in general like minute, usually dark-coloured or yellowish bristles or bushy hairs projecting from its chitinous integument either singly or in pairs, more commonly scattered, but often densely crowded over certain areas on which they form a furry coating." A very remarkable feature of the group consists in the fact that the sexual organs are to say the least, analogous with those of the red sea-weeds or *Florideae*. There is a female organ or procarp, furnished with a trichogyne, and the fertilising or male organs resemble the antheridia. "The spores are produced in the asci in fours or eights, in the first instance usually disposed more or less definitely in pairs, one of which is slightly higher than the other; and the members of a given spore pair are discharged together. The juxta-position of two individuals at the point of contact with the host, a condition essential for the perpetuation of the dioecious species, is thus insured in the majority of cases." Many other features of extreme interest are to be found in the volume under consideration, but enough has probably been quoted to prove the importance of these minute fungi, and to arouse curiosity as to the attitude that will be assumed by Brefeld after the perusal of this work. The species are most abundant on Coleopterous insects, but are not confined to this group. Many of the species are quite abundant in the United States; 158 species, distributed among 30 genera are described. Not a single one is included in any British Mycological work, although in all probability, many species do exist in Britain.

Maladies des Plantes Agricoles *et des Arbres fruitiers et Forestiers causées par des parasites Végétaux.*

The two volumes of this work by Professor Ed. Prillieux, containing the life-history of every fungus known to be an injurious parasite to plants cultivated in Europe, and illustrated by numerous excellent figures, is undoubtedly the most complete and best in every way for the student of Vegetable Pathology.

Phalline.

Professor Kobert (*Lehrb. der* Intoxikationen, 1897. p. 457), has given the name of phalline to the poisonous substance present in *Amanita phalloides*, Fries. This substance is a toxalbumen,

and in its action produces symptoms similar to those occasioned by poisoning with phosphorus. Phalline is a very powerful agent, even in exceedingly minute proportions, in causing the dissolution of the red corpuscles of the blood; this is followed by the liberation of certain ferments which induce complex coagulation of the blood, and consequently serious cerebral disturbance follows. From ascertained cases observed in Russia and other European countries, it is shown that a very large percentage of the deaths due to fungus poisoning are caused by eating *Amanita phalloides*, Fr. The following species or forms also contain the same poisonous substance:— *Amanita virescens*, Flor. Dan.; *Amanita viridis*, Pers.; *Amanita citrina*, Schaeff.; *Amanita virosa*, Fr; *Amanita mappa*, Fr.; *Amanita recutita*, Fr.; and *Amanita porphyria*, Fr.

It is scarcely necessary to intimate, in face of the above statement, that in future one of the duties of every Mycological Society should be to impart to the general public a correct knowledge of the characteristics of the above named fungi and their deleterious properties.

M. Boudier has described and figured (*Bull. Soc. Myc. France* 1897, p. 10, pl. 1-3) several very interesting new French fungi, some of which may probably be found in Britain. The following brief diagnoses will indicate the leading features of these species:—

Pleurotus ostreatus, var. *nudipes*, Boud. Distinguished from the typical form by the perfectly glabrous stem.

Hygrophorus turundus, var. *lepidus*, Boud. Slender, 5-7 cm. high, pileus squamulose, and with the stem shining golden orange; gills deeply decurrent, pallid; spores 9-10 × 5-6μ.

Psathyra typhæ, var. *Iridis*, Boud. Slender, 2-4 cm. high. pileus fuscous, umbonate, striate, rugulose; stem paler with a floccose ring.

Ramaria Rieli, Boud. Robust, 10-12 cm. high, ochraceo-rufous, trunk thick, whitish, branches thick, robust, sparingly divided; spores pale ochraceous, smooth, 16-18 × 5-7μ; size and colour of *Clavaria formosa*, but distinguished by the much stouter, almost undivided branches.

Aleuria olivacea, Boud. Sessile, 3-5 cm. broad, entirely olive-fuscous, outside furfuraceo-granulose, spores elliptic-fusoid, verruculose, 22-23 × 10-11μ. Somewhat resembles *Peziza badia*, but distinguished by the spores.

Ascophanus (*Cubonia*) *dentatus*, Boud. Pale brown, the membranaceous margin broken up into triangular teeth; spores globose hyaline, 9-10μ.

Helotium fulvum, Boud. Stipitate, up to 0.5 mm. broad and high, tawny-brown, hymenium and base of pedicel darker; spores elliptic-oblong, hyaline. 16-21 × 7-10μ. Growing on mosses in the axils of the leaves.

Helotium cuniculi, Boud. Stipitate, 2-3 mm. broad and high, ochraceous-yellow, hymenium darker, and with a tawny margin; spores oblong-fusiform, becoming 1-septate, hyaline 16-20 × 6-7μ. On rabbit dung.

PHÆOMARASMIUS.

Under this name Von. A. Scherffel (*Hedwigia*, 1897, p. 288, figs. 1-3) has founded a new genus for the reception of species previously included in the genus *Marasmius*, Fries, characterised by having coloured spores, the colour ranging from yellow to ferruginous, whereas the species left in *Marasmius* must have hyaline spores. A new species, *P. excentricus*, having a sulcate, ferruginous, tomentose pileus 3-5 mm. across, and a short, excentric, curved stem is described. It occurred on living bark of *Pyrus communis*, in Hungary. Some of our British species will go into this genus. The above idea is in accordance with the arrangement adopted by Saccardo in the "Sylloge Fungorum," and has its advantages. The disadvantage is as follows:—*Marasmius* is a very natural genus, as defined by Fries, but split up as above, the white-spored section will be placed in the Leucosporæ, and next to *Collybia*, its nearest ally, whereas the coloured-spored section (*Phæomarasmius*) must be placed in the Ochrosporæ, miles away from the white-spored section, and near to *Galera*, with which it has not the slightest affinity. In a similar manner the genus *Russula* might be broken up into an emended *Russula* with white spores, and a new genus *Phærussula*, characterised by having yellow or ochraceous spores, as follows—*Characteres generis Russulæ, sed sporis flavidis, ochraceis.* This genus would have to be located in the Ochrosporæ, where it has no affinities. The founding of genera on any *one* character is always objectionable, but the above

instances prove more than that. It is certainly a cheap bid for notoriety, which it secures, even if not of the kind desired by the author. Scherffel credits Fries as having founded the *Marasmius* with white spores, and himself takes the credit for *Phaeomarasmius;* but obviously this is illogical, neither of the genera as proposed by Scherffel correspond to the natural genus *Marasmius*, as conceived by Fries; both are founded by Scherffel, whose name must be written after every species by those who accept his arrangement.

THE DUBLIN FORAY.

HOWTH, POWERSCOURT, BRACKENSTOWN, BALLYARTHUR, LUCAN AND DUNRAN.

19-24*th September*, 1898.

The second annual week's fungus foray was held at *Dublin* under the auspices of the *Dublin* Naturalists' Field Club, and a right royal welcome was extended to the Society and its members by the *Dublin* Club. The botanical rooms in the Science and Art Museum, *Kildare Street*, *Dublin*, were kindly placed at their disposal by the Director, Colonel Plunkett, and the Keeper of the Herbarium, Professor T. Johnson, D.Sc., who spared no effort in arranging for the exhibition of the fungi from day to day collected, and procuring all books, microscopes, and other apparatus necessary for their determination.

Monday, the 19th of September, had been devoted in the programme to setting out and determining specimens sent in; but, owing to the drought that had prevailed for a long time, the members found there were scarcely any to deal with, and so a preliminary ramble was organized to *Howth*. Before starting Professor Johnson presented each member with a copy of "The fungi of the Counties of *Dublin* and *Wicklow*," by our member, Mr. Greenwood Pim, M.A., reprinted from the "Irish Naturalist" for August, 1898, and which enumerates over 830 species. *Howth* demesne proved to be a most suitable hunting ground, and nice specimens of *Hydnum udum* Fr., *Naucoria erinacea* Fr., and *Lepiota acutesquamosa* Weinm. were obtained, and an immature tuber was found, probably *Hydnotrya Tulasnei* B. & Br. In the evening Mr. R. Ll. Præger, M.R.I.A., President of the *Dublin* Naturalists' Field Club, received the members at the Botanical Laboratory, Royal College of Science, *Saint Stephen's Green*, and the naming of the specimens was at once proceeded with. Mr. Swann, F.L.S., exhibited a splendid series of photographs of the

Saprolegnieæ, which were of great interest, and contained at least one new to science.

On Tuesday, the 20th of September, *Powerscourt* demesne was visited, but only a few species of interest were collected, and these included *Polystictus Wynnei* B & Br. and *Marasmius Hudsoni* Pers. The Club dinner was held in the evening at Russell's Hotel, under the presidency of the Acting President, Mr. Charles B. Plowright, M.D., who subsequently delivered his presidential address in the Lecture Theatre of the Royal College of Science, entitled, "Notes and comments on the Agaricini of Great Britain" (see p 37).

On Wednesday, the 21st of September, the morning was spent in working at the herbarium and on determining the consignments of fungi which then came to hand from all parts of *Ireland* and from some parts of *England* as well. In the afternoon a search at *Brackenstown*, near *Swords*, was made, where *Hypocrea splendens* Ph. & Pl., *Rosellinia mammæformis* P., *Nolanea pisciodora* Cesati, *Poria vitræa* Pers. and *P. obducens* Pers. were found. At the evening meeting a very valuable paper was read on behalf of our member, Mr. Harold Wager, F.L.S., Inspector of Science to the Department of Science and Art, on "A fungus parasite on Euglena," wherein he recorded that the reproduction of *Polyphagus euglenæ* Schroet. is effected under normal conditions by the production of sporangia from the central or main portion of the organism. The nucleus and protoplasm pass into this sporangium, and the nucleus then divides first into two, then four, eight, sixteen and so on until about 128 nuclei are produced. Around each nucleus a small portion of the protoplasm collects; these masses become rounded off; each becomes surrounded by a membrane and thus 128 cells are formed, each of which is a spore. Each spore possesses a single cilium, and when the sporangium bursts the zoospores move away freely, and after a lively swim of about one hour or so, they settle down and soon develop into adult forms similar to the parent. This process of zoospore formation is completed in about 12 hours from the time when the sporangium commences to form on the parent cell. When the supply of healthy *euglenæ* begins to diminish owing to the repeated attacks of the parasite, the latter begins to produce its resting spores (zygospores or zygotes). These are produced as the result of a simple sexual fusion of the contents of two cells. A rhizoid from a somewhat small cell comes into contact with a large celled individual, and there swells up into a thick walled projection of a spherical form. The nucleus and protoplasm, both from the small cell and from the large cell, pass into this thick walled cell and there ultimately fuse together to form a uninucleate resting spore. This spore then remains in a quiescent state until again brought into a suitable environment when the thick

spore wall bursts; a sporangium is then put forth and zoospores are developed in exactly the same manner as in the asexual form. Dr. C. B. Plowright made some observations on "A clover-destroying fungus." The election of officers was then proceeded with, universal regret being expressed by all the members that their President, Mr. George Massee, F.L.S., was unable to attend the meeting. Dr. C. B. Plowright, was unanimously elected President, and Mr. Carleton Rea, B.C.L., M.A., elected Hon. Secretary and Treasurer. Mr. Rea, reported that he had enrolled 5 new members; 1 member, Mr. Nicholson, had resigned; and that the cash balance to their credit at the Post Office Savings Bank was £11 18s. 0d. An invitation from the Reverend Dr. Stevenson, on behalf of the Cryptogamic Society of Scotland, to join their meeting next year or the year after was then considered, and it was decided that as next year was the Scotch semi-jubilee, the year after would be more acceptable, and that the annual week's foray next year should be held in the *New Forest.*

On Thursday, the 22nd of September, the woods of *Ballyarthur* were explored and yielded specimens of *Boletus parasiticus* Bull., *Russula lepida* Fr., *Entoloma jubatum* Fr., and countless ascophores of *Chlorosplenium æruginosum* De Not. In the evening Dr. C. B. Plowright read a paper entitled "Recent observations of Professor Eriksson's on the rusts of our cereals" (see p. 76).

Friday morning, the 23rd of September, was devoted to work at the museum, and in the afternoon the demesne of Woodlands, near *Lucan*, was investigated, where fine specimens of *Amanita strobiliformis* Vitt., and *Cortinarius* (*Phlegmacium*) *fulgens* Fr. were gathered.

In the evening Mr. Greenwood Pim, M.A., exhibited some moulds under the microscope, including *Pimina parasitica* Grove, a full description of which is published at p. 65, and he also read a short note (see p. 65) concerning them. Dr. E. J. McWeeney made some observations on "Two sclerotia diseases of potato" (see p. 67). On behalf of the Rev. Dr. Keith, of *Forres*, examples were exhibited of *Puccinia ribis* D.C. on *Ribes rubrum* by Mr. H. T. Soppitt. This species has hitherto not been recorded for Britain, and had been met with at *Dallas, Elginshire.* Mr. Soppitt also showed the teleutospores of *Puccinia Pringsheimiana* Kleb. on *Carex Goodenowii* he had artificially produced from the well-known æcidiospores of *Æcidium grossulariæ* Gmelin, and presented the specimens to the *Dublin* Museum. Mr. C. Rea read a few notes on "The different names applied by English and French mycologists to one and the same basidiomycete." A very hearty vote of thanks was then unanimously voted to Professor

T. Johnson, D.Sc., for the great amount of trouble and labour that he had expended on behalf of the Society in selecting suitable places for the daily forays, personally conducting the members on their excursions, obtaining necessary permissions from landowners, arranging terms with the different railway companies and car drivers; in fact, the great success of the *Dublin* Foray was in great measure to be attributed to his untiring exertions To the Royal College of Science, the Museum authorities, the *Dublin* Naturalists' Field Club, and the owners of the different demesnes visited the best thanks of the Society were tendered for so kindly assisting them in every way.

Saturday, the 24th of September, was the concluding day of the week's foray, when the members visited the picturesque demesne of *Dunran*, by the kind invitation of Mr. Paterson, who subsequently most hospitably entertained them to luncheon. The demesne proved to be an excellent collecting ground, and was the dampest one visited during the week. *Boletus porphyrosporus* Fr. was found in some abundance, and a solitary example of *Hydnum cinereum* Bull., new to the British Fungus Flora, was obtained. Over 430 distinct species of fungi were identified during the week's foray, of which over 160 were additions to Mr. Greenwood Pim's list, and the most interesting are enumerated in the subjoined list.

LIST OF THE MORE UNCOMMON FUNGI OBSERVED DURING THE IRISH FORAYS 19th–24th SEPTEMBER, 1898.

Amanita porphyria Fr.
strobiliformis Vitt.
Lepiota sistrata Fr.
Tricholoma resplendens Fr.
inamoenum Fr.
Clitocybe fumosa Pers.
Collybia nitellina Fr.
clavus Linn.
Mycena Iris Berk.
acicula Schaeff.
amicta Fr.
pullata Berk & Cke.
Pleurotus subpalmatus Fr.
Eccilia griseorubella Lasch.
Inocybe eutheles B. & Br.
Naucoria erinacea Fr.
escharoides Fr.
Coprinus lagopus Fr.
Cortinarius (Phlegmacium) infractus Fr.
fulgens Fr.
(Dermocybe) cinnamomeus Fr. var. semisanguineus Fr.
(Hygrocybe) castaneus Bull.
Hygrophorus nitratus Pers.
Russula galochroa Fr.
Marasmius Hudsoni Pers.
Boletus parasiticus Bull.
aurantiporus Howse.
porphyrosporus Fr.
Polystictus Wynnei B. & Br.
Polyporus lentus Berk.
Poria vitrea Pers.
obducens Pers.
radula Fr.
Hydnum cinereum Bull.

Cyphella villosa Karst.
Pimii Phill.
dochmiospora B. & Br.
Puccinia hydrocotyles Link.
Melampsora epitea Kze & Schum.
Chætocladium Brefeldii Van T.
Peronospora urticæ De Bary.
Orbilia auricolor Sacc.
Ascobolus vinosus Berk.
atrofuscus Phil. & Plow.
Ascophanus carneus Boud.
Erinella juncicola Fckl.*
Lachnea hybrida Phil. var. lapidaria Cke.
dalmeniensis Phil.
Hydnotrya Tulasnei Berk & Br.
Nectria aquifolia Berk.
Ralfsii B. & Br.
dachrymella Nyl.
Eutypa Acharii Tul.
Nummularia Bulliardi Tul.
Hypocrea splendens Phil & Plow.

* A distinct species included by Massee, Vol. 4, p. 303 British Fungus Flora under E. apala, which is fawn colour outside, while this is quite white and much smaller in the ascophore but the spores are longer.— *Chas. Crossland.*

NOTES AND COMMENTS ON THE AGARICINI OF GREAT BRITAIN.

By Charles B. Plowright, M.D.

Presidential Address.

Ladies and Gentlemen,

I need hardly say how great an honour I esteem it to occupy the presidential chair this evening on the occasion of the visit of the British Mycological Society to *Dublin*.

Mycologists, if not a numerous body, are a very clannish one, and it seems to me that I am only meeting old friends. Our studies are beginning to be far more appreciated by our fellow-citizens than they once were, but after all we only constitute a very small section of the Army of Progress. One advantage of belonging to such a small corps is that we all know each other and that we are always certain of meeting with sympathy and kindness amongst our co-workers in whatever country we may happen to be—not only amongst English-speaking people, but in places where they do not speak English—at least, such has been my experience whenever I have been in *France*, in *Holland*, in *Sweden*, in *Denmark*, and in *Italy*.

It is sufficiently obvious that our Irish confreres are not behind-hand in the warm-heartedness of their reception of us. Needless to say we anticipate an exceptionally pleasant meeting, and that we hope to learn much from you.

Long presidential addresses are seldom interesting, dealing as a rule with generalisations; they lack the piquancy of concrete facts; generally they are too long, and being usually *post prandial*, they are commonly soporific. Deeply regretting my inability to give an address which shall be at the same time eloquent and interesting, I have to fall back upon the records of some thirty odd years of practical fieldwork amongst the larger fungi.

In the later half of the sixties, a few of us who devoted our attention—and I may truthfully say derived our greatest pleasure—from the study of fungi, began annually to meet at *Hereford* under the genial auspices of the Woolhope Club, impersonated in the energetic and kind-hearted secretary, the late Dr. H. G. Bull. We were but few in number, but we were full of enthusiasm. Messrs. Berkeley, Broome, Bull and Currey have joined the majority, but Worthington Smith, W. Phillips, M. C. Cooke, Howse, Spencer Perceval, Bucknall, Vize, and myself remain to look back with pleasant remembrances of our yearly gatherings in the cathedral city of the West of England. We soon found that to do any good with the larger fungi we must sketch them—otherwise what we learned one year we forgot the next. Many of us were skilful draughtsmen; but whether we were skilful draughtsmen or unskilful, we had to do our best, and we should as soon have thought of going to *Hereford* without our paint boxes as we should have thought of going without our hats. Now it was my misfortune not to belong to the skilful draughtsmen group, but for all that I had to do the best I could, and it is surprising how true the old adage proved—"Where there is a will there is a way"—for after a time I did succeed in producing sketches which the initiated were able to recognize, when the names were written with sufficient legibility beneath the species. We were all good friends; we had no petty jealousies: when a fungus was found at *Shrewsbury* it made its way to *Hereford*, to *Norfolk*, to *London*, to *Batheaston* and to *Sibbertoft*, and *vice versa*. As years rolled on, Dr. M. C. Cooke began to publish a series of coloured plates of the *British Agarics*, and although he personally up to that time had paid very little attention to this particular group of fungi, yet by his indomitable perseverance he managed to produce a figure of almost every British species. We all of us placed our sketches at his disposal. Now it is very curious how after a little practice one is able to catch the character of a fungus on paper; and so, although many of our sketches—at least mine were, I know—innocent of perspective, devoid of detail in the matter of shading, badly drawn and worse coloured, yet they formed the basis from which it was possible to construct very useful figures. The sketches of Mr. Worthington G. Smith W. Phillips, Dr. Bull, and C. Bucknall, do not, of course, belong to the same category. The point I wish to emphasize is this: that however rude a sketch may be, it has a definite value; and I would impress upon all those who attempt the study of the Hymenomycetes that they should make coloured outlines of any species that may be new to them. The trouble is not great, but the value, as these sketches accumulate, considerable. Those of us who have devoted any length of time to the study of these fungi, will not fail to have been struck by the difficulty of recognising species from descriptions,

and even with the aid of figures it is not always easy to be sure of your plant. We have all of us had for years the wrong plant in view with regard to certain species ; and it is only by such meetings as these that we get our errors corrected. Often, too, we have mistaken some rare species for a common one, and have had to climb down pretty considerably. The common species are the most difficult to recognize ; they are more prone to vary, and many of them devoid of marked characters.

In Dr. Cooke's "Illustrations of British Fungi" more than 1,000 species of Agarics are figured. No one who has had to do with the recognition of such a number of species can expect not to make some slips —it is impossible with such species as these Agarics not to fall into some errors. Those who have had to do with the publication of coloured figures know what a knack the figures have of not coming out the same colour as the copy. Hence, I venture to think that, if I can succeed in pointing out a few of the errors in these magnificent series of figures of Dr. Cooke's I shall be doing a service to those who have occasion to make use of them. Let me not be misunderstood, these criticisms are not offered in any captious spirit, nor in any way to disparage the laborious undertaking of the author but rather to increase the value of the work by correcting such errors as it lies in my power to do.

Let us begin with the Amanitae.

Amanita pantherina D. C. There are two distinct fungi confounded under this name. They are neither of them very common in this country. One of them is figured by Paulet t. 162, f. 2, and doubtless figures 1 and 3 on the same plate are also intended for it. It is a more slender plant than the other, having a dark brown or umber brown pellicle which has but little tendency to become pale, with small persistent white warts.

The other species is figured by Krombholz t. 29, f. 10 to 13, Schaeffer t. 90 and Paulet t. 161. This is a much stouter fungus with a thicker stem, and not so distinctly white warts which are usually larger. The pellicle is paler but more umber than brown and decolourizes rapidly with age. The character common to both and to which Fries attached so much importance is the adnate ocreate volva with an obtuse edge. In our early days many of us fell into the error of expecting an ocreate volva to show signs of an ochre colour just as roseate implies a rose colour. I need hardly tell you that ocreate is a botanical term implying that the volva embraces the stem as a stocking does the leg. In Cooke's "Handbook of

British Fungi" *Amanita pantherina* is said on the authority of Mr. Worthington G. Smith to be " not poisonous," but however fungus proof Mr. Smith himself may have been when he wrote this since then it has caused so many deaths in France and Germany that it ranks between *A. phalloides* and *A. muscaria* as one of the most lethal species. It is the first of these forms which Cooke Ill. pl. 6 probably represents.

Amanita strobiliformis Vitt. is a very uncommon species represented in the "Illustrations" pl. 8 by a fungus with a dark reddish brown cuticle from a figure of Dr. Bull's: this however is quite wrong, and was corrected by the issue of a second figure plate 277, which shows a group of three said to have been found at *King's Lynn*. This, however, is a mistake. I never found but a single specimen that was in 1871 on *Ringstead Downs:* it was solitary, fully expanded and flat on the top, but the warts were quite distinctive being large angular, persistent and mouse grey.

Amanitopsis vaginata Roze. Fries in the "Monographia" points out that Persoon divides this into two species (*livida and spadicea*). Schaeffer makes four of it and Secretan ten: so that he himself thinks the wisest plan is to group all forms under one. Whatever grounds the above authors may have had for so much sub-division yet I think the two common forms the grey and the brown (*livida and spadicea*) have fair grounds for specific rank. Not only, as the master himself points out, does one appear earlier in the season than the other but also there are certain distinctive characters in the volva. In both one may often observe, as Dr. Stevenson says in "British Fungi," vol. 1, p. 11, that the ring though obsolete is present more or less conspicuously at the base of the stem enclosed in the volva: but more than this as my esteemed friend, the Rev. Dr. Keith, whose practical knowledge of the Hymenomycetes of his own country is unsurpassed, pointed out to me in the reddish brown form (*spadicea*) there is a second volva inside the outer. In the grey form (*livida*) there are folds or wrinkles of considerable size on the inner surface of the volva.

Amanitopsis adnata W.G.S. is an Amanita which seems to be getting more common than when it was first recognised by Mr. Smith from specimens from *Somersetshire* in 1871. It is well figured in Saunders and Smith's "Mycological Illustrations" t. 20 as a ringless species. Five years later Dr. Quélet described and figured (Bull. Soc. Bot. de *France*, 1876, t. iii. f. 10) under the name of *A. junquillea*, a very similar fungus but with a ring. Last year I

gathered Quélet's species near *Paris* during the excursion of the Societé Mycologique, and on my return I found near *King's Lynn A. adnata* in a new habitat where I had ample opportunity of examining it carefully. One of the first points noticed was that some specimens had a ring while others had not so that it is evident these two species are identical but Mr. Smith's name has the priority.

Lepiota Vittadinii Fr. Another rare fungus which has never appeared at any of the fungus shows I have been at. I have found it but once when it was growing in some long grass in an unused gateway by a road side. Many of the warts had fallen off of themselves and laid upon the ground beneath and around the fungus. The figure in the Illustrations t. 36 is after Krombholz t. 27 and a better one cannot be.

Tricholoma equestre Linn. is a fungus rarely found in England but one of great beauty which ornaments the pine woods of Scotland to a limited extent, being of a brilliant yellow beneath, brighter even than *T. sulphureum*. The colouration of pl. 72 is as much too pale as that of the next species *T. sejunctum* t. 53 is too bright.

Tricholoma portentosum Fr. Pl. 54, is from a sketch of Mr. James Renny, I believe everybody admits that the plant figured is *Collybia platyphylla* and not *portentosum* at all.

Tricholoma acerbum Fr. Pl. 76 shows the character of the plant but is much too dark in colour.

Tricholoma flavo-brunneum Fr. Pl. 58 is not a typical figure if it be one of the plant at all. The stem is too stout and there is no trace of yellow about the gills which is distinctive of the true plant.

Tricholoma vaccinum P. Pl. 60 again is not so good a figure as it might have been. The true plant has a thinner stem and while the scales on the pileus are less numerous than those in the sketch they are larger. It was originally published as a figure of *Trich. imbricatum* but the author corrected the name.

Tricholoma immundum Berk. Pl. 61 probably from Berkeley's original figure is another uncommon species. I have met with it in two localities near King's Lynn, and M. Boudier showed it to me last year in the Forest of Compeigne. It may always be known by its pale stone colour and by turning first dark blue and then black when bruised.

Tricholoma virgatum Fr. Pl. 167, is I believe from a figure of mine made in August 1883. The great character is the striæ on the pileus but these are not nearly so pronounced as the plate would lead one to suppose.

Tricholoma inamœnum Fr. Pl. 77 has generally a tinge of buff colour and is not so elongated a plant.

Clitocybe rivulosa Fr. Pl. 200 and its variety *neptunea* Batsch. This is a very common fungus amongst short grass especially on road sides, but it is one over which we all came to grief and it is only through the kindness of M. Boudier that we were set right. In Fries "Hymenomycetes" the sub-division Disciformes of the Clitocybe is split up into five groups: in the fourth of which Cl. rivulosa is placed. This group is characterized as "Pileo viridi, pallescente," now it so happens that *Cl. rivulosa* has no trace of green about it anywhere. The subsequent writers (Stevenson, Cooke and Massee) have simply copied and re-copied the error hence in our attempts to make out the fungus from our English handbooks we have always passed over the group which contained the description of *Cl. rivulosa*. Various names have been suggested for the plant in question--*e. g. A. dealbatus*, *gallinaceus*, *obsoletus*, *diatretus*, *&c.*, but there is no doubt that *Cl. rivulosa* is the fungus Fries originally had in view. It is a small whitish species which in wet weather looks as if it had a coat of white varnish and it is the cracking of this coat in a rivulose manner which gives the fungus its name When growing and well grown it has a very pale flesh coloured tint, but this is not observable on every specimen: with age it becomes light in colour and distorted in form. I am by no means sure that Hussey t. 39, lower figure is not intended for a sodden condition of this plant: the upper figures of Cooke "Illus." pl. 104 (*A. dealbatus*) is probably also the same thing although the stem is rather stout.

Clitocybe maxima Fr. and *gigantea* Sow. are two frequently confounded species, and although they have in common the character of magnitude they are otherwise abundantly distinct. It may facilitate the remembrance of their individuality to recall the fact that Fries in the "Monographia" classes *A. giganteus* with the *Lepistæ*. It is not only very large but it is infundibuliform with crowded gills and a short stout stem an inch and a half or two inches long and nearly as much thick. Cooke's figures in the "Illustrations" 135 appear to be *Clitocybe geotropa*.

Clitocybe flaccida Fr. and *inversa* Scop. are I believe indis-

tinguishable, unless one decides by colour alone taking *inversa* to be the brick red and *flaccida* the yellowish brown plant.

Clitocybe Sadleri Berk. (Cooke "Illus" pl. 127) is nothing but a distorted form of *H. fasciculare* as its cæspitose habit, its colour and its acrid bitter taste show. It is one of the peculiarities of *H. fasciculare* that it often fails to produce spores on its hymenium so that the gills remain sulphur yellow. One or two such specimens generally turn up at each fungus show. I have several times seen it in this condition at *Hereford*, as well as at *Selby* and *Worksop*. It does not seem that the spores are deficient in colour, but that they are not produced at all.

There are three *Collybiæ* either growing upon fir cones or under fir trees, both Spruce and Scotch, which are very difficult to differentiate, viz. *Collybia tenacella* Jacq., *esculenta* Pers., and *conigena* Pers. They are all common, and occur all the year round; but personally I must admit my inability to discriminate them and would recommend their special study to the members of the Mycological Society. It may be that they are three good species, or it may be that there are only two.

Mycena Iris Berk. a by no means uncommon, but frequently overlooked Mycena, since the blue fibrillæ disappear almost as soon as the plant is above the ground level. They are seen to the best advantage on those young specimens which are coming up amongst fir needles. If a handful of the loose needles be gathered in which a very ordinary looking pale brownish Mycena is growing, and the bases of the stems examined, young plants with the blue fibrillæ may generally be found. There is no really good figure of this fungus: Berkeley's "Outlines," t. 6 fig. 3 is perhaps the best. Cooke Ill. plate 161, lower fig., is from Berkeley's original sketch. Bresadola's *Mycena calorhiza*, t. 5 fig. 1, is the same plant.

This last named plate is grotesquely over-coloured, an error into which those who paint fungi with water colours do not generally fall. This mistake is usually in the opposite direction—not getting the tint dark enough. There are two pink-spored species which it is hardly possible to depict in sufficiently brilliant colours, viz., *Pluteus leoninus* Schaeff. and *Leptonia euchroa* Pers. The figures in the "Illustrations" (421 and 334) convey but a very inadequate idea of the brightness of the colouration, either of the orange or of the blue; and if you try to figure them yourselves you will find that your colour box does not contain pigments of sufficient brightness.

On plate 422 of the "Illustrations" a curious but not rare form of *Pleurotus subpalmatus* Fr., is depicted under the name of *Pluteus phlebophorus* var. *reticulatus* Cke.

Pholiota caperata Pers. a firwood species found hardly anywhere else than in Scotland, I believe. The plant figured in the "Illustrations" 348 under this name is from a sketch of Mr. Phillips of *Pholiota aurea*, which he made from a specimen we found in company with Rev. Dr. Stevenson on 24 September, 1886, at the *Den of Airlie*. The stoutness of the veil which was covered beneath with brown furfuraceous scales was very distinct. *Ph. caperata* has a membranous veil, it is a much more tender plant; in fact, in the "Epicrisis" and "Monographia," Fries places it amongst the larger *Cortinarii* but in the "Hymenomycetes" he puts it back again amongst the *Pholiotæ*.

Pholiota comosa Fr. pl. 600 and *P. heteroclita* Fr. pl. 366, are two excellent figures of the same plant as is now pretty generally admitted by Mycologists. The first name has the priority.

Pholiota flammans Fr. pl. 368 is taken from a figure the late Dr. Bull made from specimens I sent him from *Dunoon* in August 1872. Oddly enough, the main character of the plant is entirely missed, viz., the sulphur yellow scales on the pileus, which are *paler* than the cuticle.

Pholiota Cookei Fr. pl. 354 and *Ph. terrigena* Fr. pl. 349 are two Friesian species, but they are really identical.

Flammula astragalina Fr. pl. 435 shows no change of colour on injury as it should do: this is a point made the most of generally in sketches of fungi.*

Hebeloma testaceum Batsch. f. 198 is a well-marked variety of *H. crustuliniforme* Bull, which is entitled to rank as a species. It is easily recognized by its distinctly bulbous stem, and is pretty common in fir woods and heathy places during October and November.

Stropharia Percevalii B. and Br. Ill. pl. 550, is only a form of *St. depilata* Pers. The former has a hollow stem while the latter has a solid one. In the year 1888 I gathered at *Floda* near *Gottenburg*, in company with Dr. Fries a series of specimens of

* Mr. George Massee refers this plate to *F. rubicundula* Rea (see Grevillea vol. 22 p. 40, pl. 185).

St. depilata, which were sketched at the time. The sketches show that *depilata* has sometimes a distinctly hollow stem.

Hypholoma lacrymabundum Fr. is a species which has proved a terrible stumbling block to British Mycologists. It is not a very common species and what generally goes by the name *lacrymabundum* is the next species *H. velutinum*. Messrs. Berkeley, Broome, Smith, Cooke, Phillips, and myself have all come hopelessly to grief about it. For some reason or other Mr. Berkeley named some specimens exhibited at *South Kensington* in 1873 as well as others from *Coed coch* and *Ascot*, *A. storea* regardless of the fact that they were densely cæspitose while *storea* is always solitary. We all of us followed Berkeley without hesitation until the publication of "Fries Icones" when the Rev. Dr. Keith immediately recognised our so-called *storea* to be the true *lacrymabundum*. In 1888 I showed specimens to Dr. Robert Fries, of *Gottenburg*, who unhesitatingly pronounced them to be *H. lacrymabundum*. So deeply has the name *storea* got hold of the English mind that Mr. W. G. Smith in looking over some sketches of mine three years ago marked one of this plant *H. storea*. The figure in the Illustration 543 is *H. lacrymabundum* as is also *A. hypoxanthus Ph. and Pl.*

Cortinarius (Phlegmacium) triumphans Fr. One of the best figures in Cooke's "Illustrations" is pl. 703 from one of Dr. Bull's sketches. It is a well known plant but by a curious accident is wrongly referred to *C. saginus*—an accident which arose from no fault of the author. In 1888 I gathered the fungus figured near *Gottenburg* with Fries's son, Dr. Robert Fries, who unhesitatingly pronounced it *C. triumphans*.

Cortinarius (Telamonia) torvus Fr. pl. 801 and *C. impennis* Fr. Ill. 853, differ only in the larvae tracks in the stem. This fungus whichever species this may eventually prove is very common round *Hereford* and elsewhere in *England*. It has nothing to do with the plant the *French* Mycologists regard as *C. torvus* nor do Fries' figures in the "Icones" help us.

Lactarius exsuccus Smith. This fungus is well known in this country, and was at one time regarded as a variety of *L. vellereus*. Mycologists in *France* as well as in *Sweden*, however, do not consider this to be a *Lactarius* at all but the *Russula delica* of Fries.

Lactarius theiogalus Fr. This is a common *Lactarius* but one which is easily overlooked. There is no good figure of it. It is a

fir wood species often found amongst heather at the margins of fir woods. Sometimes one can trace the attachment of the base of the stem to last year's dead stumps of Pteris aquilina stems but not always. In colour it is one of the red brown group resembling *L quietus*, *subdulcis*, *serifluus*, etc. It differs mainly, however, in having when young a suggestion of liver colour, in the gills being rather distant and the margin of the pileus crenulate. It is very hygrophanous becoming when dry pale brown. The great character is in the milk, which is white and which remains white for some considerable time but it eventually becomes pale sulphur yellow. Here again I am indebted to my esteemed friend M. Boudier. The figures quoted by Fries as being those of *L. theiogalus*, namely—Bolton, t. 9, Krombholz t. 1 f. 23 and 24, and Bulliard t. 567 f. 2, may be of anything. M. Boudier, however, thinks the figures of Bulliard are *L. chrysorrhæus*. The best figure of *L. chrysorrhæus* is in Cooke's "Illustrations" pl. 984.

Lactarius helvus Fr. A common species commonly mistaken for an old *L. torminosus*. I am informed by his son that Fries attached no special meaning to the word *helvus* beyond yellow. Cooke's Ill. pl. 974 is typical *L. helvus*, but pl. 994 certainly is not.

Marasmius urens Fr. Cooke Ill. pl. 1,116 is far too dark on the pileus the real plant being more the hue of M. oreades. "Berk. Outlines" t. 14 f. 3 is a much better figure. It is an uncommon plant. I never have met with it but once and that was at *Mattishall*, *Norfolk*, the former residence of the Rev. Canon Du Port.

Marasmius cauticinalis With. is a beautiful yellow fungus which for a few years grew abundantly on *Merryhill Common* near *Hereford*, under some Scotch fir trees. I have never seen it before nor since. The figure in the Ill. pl. 1,134 is much too dark on the pileus.

It is, however, high time to stop, when one has devoted upwards of thirty years to the study of any particular subject and gets a chance of talking about it he is apt to become wearisome.

A POTATO DISEASE.

By H. Marshall Ward, *D.Sc., F.R.S., Professor of Botany in the University of Cambridge.**

I have for some time past had occasion to recognise here and there, in various parts of *England*, a potato disease which is not due to *Phytophthora*, and which has often been ascribed to bacteria. During the past two years my attention has been especially directed to testing its bacterial origin, and I am convinced it is not due to bacteria, but to a true hyphomycetous fungus.

Without going so far as to say there is no bacterial disease of the potato, I wish to express the conviction that the alleged cases of such lately published are not convincing, and that a tendency exists to draw conclusions from imperfect evidence.

I shall show that the way into the tuber is prepared for bacteria by fungus hyphæ, and the open passages of destroyed vascular bundles afford them ample space. The disease I have studied has appeared in a more or less epidemic form at least twice in my experience : it was very common two years ago, and this year has been abundant in various parts of *England*. In a subsequent publication I shall show that it is common and wide-spread, and even known in some countries, though not adequately recognised.

Symptoms.—The shoots turn yellow and die prematurely during the summer, and before the tubers are anything like full. The disease *starts from below* and *not from the leaves*. The roots are few and poor, and soon rot away. The tubers are few, do not mature, and often rot in the ground. The leaves turn yellow and wither on the stems, with the symptoms of *premature wilting*, and often remain long hanging on the yellowing, glassy-looking, but still living stems.

In very mild cases these symptoms are not obvious, and supervene

*Reprinted from Abstract of papers read at the British Association Meeting, 1898.

slowly, and the case may be complicated by the co-existence of *Phytophthora*. In very severe cases, on the other hand, especially in wet situations, the stems and roots may be all rotten by the end of July, and casual observation may ascribe the damage to *Phytophthora* entirely. In ordinary cases, again, it is easy to suppose the damage due to some insect attack, or to drought.

In advanced stages of the disease the stems either dry up to brown sticks, or putrefy on the wet ground; very often bacteria have gained access to the tissues at a comparatively early stage.

Microscopic Appearances.—Sections across the lower parts of the attacked stems show one, two, or more of the vascular bundles yellowish-brown—visible even without a lens—and the principal vessels of these contain branched, septate hyphæ. In several cases I have traced these hyphæ through every internode of the stem, into the petioles of the still hanging leaves, into the young lateral shoots, throughout the roots and subterranean rhizomes, and *up to and even just into the tubers.* In two cases I have done this in one and the same potato-plant, and so have no longer any hesitation in ascribing the disease to this fungus, the morphological features of which will be described in a subsequent paper. In advanced cases the brown vessels are stopped with a yellowish gum-like substance. Tyloses are common in the vessels of the root. Those tubers which are not attacked while still very young, but which have already begun to fill with starch, may offer considerable resistance to the invasion of the fungus; bnt eventually the vascular strands diverging from the point of attachment to the rhizome exhibit the tell-tale foxy-red or yellowish-brown colour, and in many cases the ripened tubers are to all appearance sound, except for *microscopic reddish spots just at the points of entry of these bundles.*

During the winter the stored potatoes, with the fungus thus just lurking in them at the morphological base (the so-called heel) of the tuber, may undergo little change to all appearance if *gathered and stored dry.*

But, if wet, various kinds of rot may supervene, owing to the *subsequent invasion* of various micrococci, bacteria, fungi, &c., following the lines of weakness opened up by the fungus in question, and living as saprophytes on the stored reserves.

In some cases even apparently dry tubers may undergo a curious rot—dry-rot—owing to the ravages of a particular bacterium or mould, perhaps more than one, which finds sufficient moisture for its purposes.

The principal point is that the fungus I have especially studied leads the way for these purely saprophytic anaërobic and aërobic forms into the tuber: once in the mature tuber, its progress is necessarily slow until the reserves move in the spring.

During the past winter I gave to Miss Dawson, who is working at such subjects in my laboratory, some of the tubers saved from plants attacked with this disease, to investigate the various fungal forms lurking in the diseased tubers. Her investigations are not yet completed, but enough has been accomplished to convince us that after the fungus in question has opened up the way into the tuber, all sorts of bacteria and fungi can make their way down the destroyed vascular strands, and reappear in spring, when the tubers are replanted.

But this is not all. The evidence shows that the fungus in question, once in the tuber, leads a dormant life during the early part of the winter, but gradually invades the new sprouts as they slowly appear in the early spring, and that *the parasite is actually replanted* by the farmer or gardener, when restocking the ground, *in his new "sets."*

If we reflect that the tuber is really a bud, there is nothing especially strange in this phenomenon; the fungus enters the base of the bud in autumn, and takes some months to traverse its dormant tissues during the winter and spring. A spotted tuber may give rise to some healthy and some diseased sprouts, according to the tracks of the fungus.

A curious phenomenon was observed in some potato plants very badly attacked by this disease this summer. In some of the badly diseased young shoots quantities of beautifully developed *cubical proteid crystals* (crystalloids) were observed in the parenchyma of the pith and cortex. It is due to Mr. W. G. P. Ellis to point out that he was the first to see these in some sections he was kindly cutting for me of this batch of specimens. On going further into the matter I find such crystalloids have been seen by Heinricher in the shoots of a diseased potato (1), but he did not give any account of the disease itself.

I find these crystals are not uncommon in the still green bases of the petioles of the withered leaves hanging on the diseased shoots, though they do not always occur.

I ascribe their formation to the accumulation of proteids in the

(1) Ber. d. deutsch. bot. Ges. 1891.

leaves, while still living and active, from which the passages of transference at the nodes of the stem have been cut off by the fungus; just as the eventual withering of the leaves is due to the blocking of their water conduits when all the vessels are stopped up.

At the same time, the attempts I have made to induce the formation of these crystalloids artificially have failed so far.

Neither ringing, nor ringing combined with destruction of the pith with a hot skewer—to destroy the internal phloëm—has given satisfactory results as yet, though the leaves of healthy plants withstand this drastic procedure much better than might be supposed.

Here again I must reserve further particulars for the fuller paper.

In conclusion, it is evident that the efforts of the potato-grower must be directed to the selection of sound sets, and to the careful preparation of his ground. I hope to show later that it is a fatal procedure, even with sound sprouts, to allow the young shoots to lie in contact with raw manures, as it is *viâ* wounds and small rotting spots at and near the collar that new infections occur. The same arguments apply to wet soils and situations, and the disease is particularly apt to increase when wet and cold weather supervenes on the early growths.

PENICILLIUM AS A WOOD-DESTROYING FUNGUS.

By H. Marshall Ward, *D.Sc., F.R.S., Professor of Botany in the University of Cambridge.**

Spores from pure cultures of *penicillium* were sown on sterilised blocks of spruce-wood, cut in March, and were found to grow freely and develop large crops of spores on normal conidiophores. Sections of the infected wood showed that the hyphæ of the mould entered the starch-bearing cells of the medullary rays of the sap-wood and consumed the whole of the starch. The resin was untouched. In culture three months old the hyphæ were to be seen deep in the substance of the wood passing from tracheid to tracheid *viâ* the bordered pits. Control sections, not infected and kept side by side with the above, contained abundance of starch, and no trace of hyphæ could be detected in them.

The observation appears of interest in several connections. *Penicillium* is one of our commonest moulds, and undoubtedly plays a part in the reduction of plant *débris* to soil-constituents; how far it can itself initiate the destruction of true wood, or how far it merely follows on the ravages of other fungi, bacteria, &c., is unknown. There are strong grounds for believing that it destroys the oak of casks, &c., but since these are impregnated with food-materials, this is not very surprising. Trabut[1] has shown that *penicillium* will grow in solutions containing 2-9·5 per cent. of $CuSO_4$, and other evidence exists showing how remarkably resistant this mould is, and how little organic matter it needs for life.

Dubois[2] showed that *penicillium*, or a closely-allied form, not only lives in strong solutions of copper, neutralised with ammonia, but will erode metallic copper and bronze if transplanted thereon.

Iönssen[3] found *penicillium* living in one-tenth normal sulphuric acid solution, and gives some interesting facts regarding the sulphur-containing oil-drops in its protoplasm, and other statements concerning oil in this fungus occur in the works of De Bary, Brefeld, Pfeffer, &c.

Gerard[4] gives proof that *penicillium* can liberate butyric acid from monobutyrine, and evidence that this it due to its power of forming a *lipase* or fat-splitting enzyme.

Lesage[5] gives striking instances of the resistance to external influences shown by the spores on germination. Not only will they germinate and live for some time in water, and under almost anærobic conditions, but he found them germinating in 26·5 per cent. solutions of common salt; 30 per cent. solutions were too much for them, however. He states also that the vapour of cedar-oil, iodoform, napthalin, camphor, and patchouli do not prevent germination; though that of clove-oil, ether, alcohol, chloroform, and acetic acid prevent it. The maximum for alcohol was somewhere between 4·2 and 6·2 per cent. In acetic acid they germinated in twenty-four days in solutions of 1 : 256, but failed to do so in solutions of 1 : 64, whereas in HCl. they germinated in two days in 1 : 4 solutions.

As regards temperatures, it is well known how resistant the spores are; a striking instance of the hardships the mycelium can undergo is given by Woronin.[6] He found *penicillium* vegetating on the melting snow, where the temperature at night fell below 0° C.

Bourquelot[7] found Invertase, Maltase, Trehalase, Emulsin, Inulase, Diastase, and Trypsin in the allied *aspergillus*, and pointed out how suggestive this is in explaining the ubiquity of this mould. Probably *penicillium* is equally rich in capacity for enzyme-production.

Miyoshi[8] showed that *penicillium* can bore through cellulose membranes, and no doubt similar chemotactic phenomena are concerned in the piercing of wood-elements by the hyphæ.

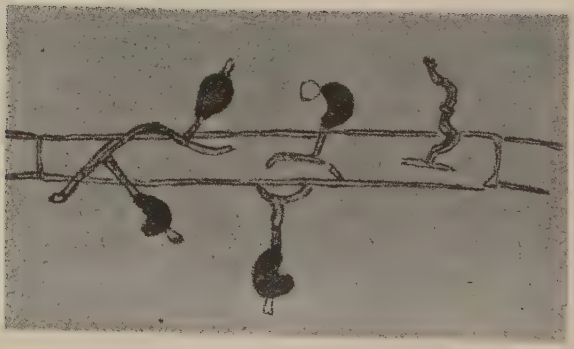
It certainly looks as if *penicillium* may be a much more active organism in initiating and carrying on the destruction of wood than has hitherto been supposed, and that it is not merely a hanger-on or follower of more powerful wood-destroying fungi. It is also, doubtless, very independent of antiseptics.

* Reprinted from Abstract of papers read at the British Association Meeting, 1898.

[1] *Bull. de la Soc. Bot. de Fr.*, xlii., 1895, 1,
[2] *Comp. Rend.*, 1890, cxi., p. 655.
[3] *Bot. Centr.*, xxxvii., 1889, p. 201.
[4] *Bull. de la Soc. Mycol. de Fr.*, xiii., 1897, p. 182.
[5] *Ann. des Sc., Nat.*, Ser. 8, T. 1, 1895, p. 309.
[6] *Arb. d. St. Petersb. Naturf. Ver.*, B. xx., p. 31.
[7] *Bull. Soc. Mycol.*, 1893, p. 231.
[8] *Bott. Zeit.*, 1894, H. 1.

PIMINA PARASITICA W.B.G.

Leitz 8 ob &
1 oc.



G. Pim. delt.

PIMINA PARASITICA W.B.G.

NEW AND RARE BRITISH FUNGI.

By Charles B. Plowright, M.D.

Continued from Grevillea, Vol. xiii., p. 73.

In June, 1874, the first of a series of papers bearing the above title appeared in "Grevillea" by Mr. W. Phillips and myself. They were continued from time to time as material for them accumulated until that periodical ceased to exist. Their object was not simply the ennumeration of species new to the British Flora, but also the record of new localities for rare species, as well as reference to any other point of interest connected with them. Since the first of the series was published the study of Mycology has undergone great change: facts which were then keenly disputed have long since been accepted without demur, arrangements and nomenclature then in vogue have become antiquated. More attention is now paid to the biological aspect of the question than to the morphogical; but to us the study of this group of plants still retains its fascination, and we hope from time to time to continue the publication of these papers.

297. *Mycena farrea* Lasch. Pileus membranaceous, campanulate, then expanded, subumbonate, sulcate, covered with a shining pruina, becoming pale, margin crenulate, stem slightly rooting, silky striate, gills adnate, thin, connected by veins, rather fimbriate, white.

Fries "Hymenomycetes Europæi" p. 134. "Icones" t. 79 f. 4.
North Wootton Heath, 24th September, 1897.
Amongst moss and heather.

Fragile, stem 2-3 inches long, pileus whitish or yellowish, often with a tinge of flesh colour, about 1·5 cm. ($\frac{1}{2}$ an inch) across, at first with a floccose margin. It is easily recognised by its white pruinose appearance, which is due to the superficial cells of the pileus being dilated into globose hollow bodies 40 to 50 μ in diameter. Pl. 2. fig. 1.

298. *Boletus radicans* Pers. Pileus pulvinate, dry, subtomentose, from olive-cinereous becoming yellow, margin thin, involute. Stem attenu-

ated below, rooting, smooth, yellow, covered with a floccose, red pruina, becoming dark where touched; tubes adnate, pores unequal, large, citrine yellow.

Persoon Syn. p. 507, Fries Hymen. p. 503.
On the road side, *Stow* Woods, 4th September, 1898.

This well-marked species I first saw at the *Copenhagen* Fungus Exhibition, October, 1888. The *olivaceous* pileus with a tinge of yellow on the tomentum is very distinctive. It is probably often overlooked as B. chrysenteron.

**Polyporus umbellatus* Fr. A specimen of this rare species was sent for identification from the Museum *Haselmere*, 9th August, 1898. It has been recorded from *Epping Forest*. Resembling *P. intybaceus* in colour, it is easily distinguished by the fact that each branch is a *bonâ fide* pileus, which is complete and umbilicate.

299. *Polyporus fragrans* Peck. Fragrant, pileus tough, fleshy, effuso-reflexed, imbricated, 3-5 cm. (one to two inches) long, 5-10 cm. (two to four inches) broad, rather thin, but sometimes thickened at the base, velvety to the touch and clothed with a minute innate tomentum, pale reddish grey or alutaceous, the thin margin concolourous and sometimes a little roughened, often sterile beneath; flesh slightly fibrous, zonate, concolourous; pores minute unequal angular, about 2-3 mm. (one line) long, the dissepiments thin, acute, toothed or lacerated, whitish, becoming darker with age, and blackish stained when bruised.

Peck. 30th Report 1878 p. 45, Saccardo Syll. vi. p. 124.

This is a very common species, which is usually regarded as *P. fumosus*, but the sweet smell readily distinguishes it. It is by no means confined to elm stumps. Specimens were sent me by Mr. Peck from *Albany*, U.S.A., many years ago, which agree with our British plant.

300. *Coprinus dilectus* Fr. Pileus cylindrical, then campanulate, finely striate, rosy white, then pale tawny, floccose or mealy, 1-2 cm. broad; stem 5-7 cm. long, whitish and *sprinkled with red powder*; volva reduced to whitish spreading squamules at the base of the stem; gills free, reddish brown, then black; spores 10×6 μ.

On dead and partially buried hawthorn sticks, Sea Bank, *King's Lynn*, *Norfolk*, November, 1898.

This beautiful addition to our flora comes near *Coprinus roseotinctus* Rea, but is apparently quite distinct. The red or rather deep orange meal soon disappears.

**Hygrophorus fœtens* Phillips. This interesting species was found on 27th September, 1895, growing amongst short grass on the Old Sea Bank at *Nottingham Point*, *King's Lynn.*

**Cyphella cuticulosa* Dicks. Spores oval, 6-8 × 4-5 μ. At first digitaliform : exactly the plant figured by Dickson.

On dead grass (*Triticum*), Sea Bank, *Terrington*, *King's Lynn*, 30th December, 1898.

301. *Ditiola (Dacryopsis) ulicis* n. sp. Pale lemon yellow becoming darker, tough, head globose then flattened, then wrinkled, at first slightly villous with a thin, white, hyaline tomentum from 1·5-5 mm. across ; stem firm, paler than the pileus, from ·5-1 mm. long, sometimes absent or extending only from the wood through the bark; hyaline-villous when young ; spores various in form. At first elliptico-cylindrical hyaline 15 × 5 μ., with four or five very marked nuclei, the outlines of which are more obvious than the spore-wall. Older spores more cylindrical, hyaline, mostly unseptate, with an oblique, large apiculus at the base, when quite mature cylindrical, triseptate 15-18 × 5 μ. Basidia slender branched.

On the dead stems of *Ulex europæus*, *North Wootton*, 26th Jan., 1899.

This fungus, which is very common, appears to have been overlooked as a young *Tremella*. It differs from *D. radicata* Fr. in being larger in the head, stouter in the stem, and not distinctly tomentose. The *D. nuda* Berk. Ann. Nat. Hist. No. 375 pl. xi. f. 14 comes nearer, but there is a total absence of the small conidia figured by Mr. Massee, presumably from an authentic specimen. Both these plants were on fir wood, whereas the present species appear to be confined to *Ulex*. *Ditiola* is such a natural though small genus that it seems undesirable to break it up without very good reason.

Pl. 2 fig. 2 four plants natural size ; on fig. 3 conidia ; fig. 4 unseptate spores ; fig. 5 fully developed spores ; fig. 6 young basidia.

302. *Lycoperdon lacunosum* Bulliard t. 52. Specimens answering to the above were found on *North Wootton* Heath, 22nd October, 1896. It is by no means impossible that the fungus figured by Bulliard is distinct from *L. gemmatum*. The peculiar depressed pits on the stem are very marked in dry specimens.

**Geaster mammosus* Chev. In considerable abundance on an old hedge bank at *Hillington*, near *King's Lynn*, October, 1896, near the habitat of *G. coliformis Pers.*

303. *Ascochyta perforans* Rob. Perithecia scattered, minute, black, ellipsoid, immersed, ostiola short, perforating the epidermis then falling off ; spores hyaline, elliptical, rather acute uniseptate.

On *Ammophila arundinacea*. *Heacham Beach*, 8th January, 1899. Apparently the spermogonia of *Metasphæria sabulatorum* according to Saccardo.

304. *Dinemasporium hispidulum* Schrad. Perithecia clustered or scattered, rather large, cupshaped, black, hairs rigid, long, straight, obscurely septate, disc glaucous, spores elongate, fusiform, curved 14-18 × 2-2·5 μ, with three or four nuclei and an oblique, short, hairlike appendage at both ends.

Schrad. Jourl. Bot. 1799 II. p. 64. Fries Summa. p. 367.
Saccardo Sylloge. Vol. III. p. 685. Spec. Vent. p. 139. t. xvii. f. 16.
On dead wood (elm) in a wood yard, *King's Lynn*, Dec., 1898.

305. *Uromyces chenopodii* Duby.

Ædidiospores. Peridia in circles of from 5-10 mm. each, amphigenous 1 to 1·5 mm. in diameter, subcylindrical, bright golden yellow, margin torn. Spores colourless, with golden yellow contents, subglobose 20-23 μ in diameter.

Uredospores. Sori pale brown, generally elongate, sometimes confluent, erumpent surrounded by the conspicuous torn epidermis 1-3 mm. long. Spores oval, rarely subcylindrical, pedicellate brown, epispore echinulate: 20-25 + 18-20 μ.

Teleutospores. Sori elongate dark brown pointed at the ends, mostly cauline, at first covered seated on bright orange spots, then naked 5-10 mm. long.

Spores brown, smooth, oval or subpyriform, apex only slightly if at all thickened, 20-35 × 18-20 μ, pedicels long, pale brown, persistent, 5-8 × 60-80 or even 100 μ.

Ædidium chenopodii, "Gardeners' Chronicle," 3 Aug., 1895, p. 135.
Uromyces chenopodii (Duby) Saccardo Syll. Vol. VII. p. 548.
Uredo chenopodii (Duby) Bot. Gall. II. p. 899.
Uromyces giganteus Speg. Dec. Myc. Ital. No. 30.
Ædidium chenopodii-fructicosi D.C. Flora franç. VI. p. 92.
Saccardo Syll. VII. p. 819.
Cæoma chenopodiatum Link. Species Plant. II. p. 45.
Uredo chenopodii Spr. Syst. IV. p. 574.

Terrington Marsh, August, 1893, Mr. Herbert G. Ward. *North Wootton Marsh*, 1893, C.B.P. The æcidiospores were also found near *Worthing* by Miss A. L. Smith, "Journal of Botany," May, 1898.

On stems, branches and leaves of Suaeda maritima.

306. *Puccinia (micropuccinia) Ribis D.C. Teleutospores.* Sori round, orbicular, surrounded by a discoloured yellow zone, chestnut-brown spores, crowded, oval-rounded at either end, apex thickened and expanded, constriction little or none, 20-30 × 15-20 μ verrucoso-punctate, beautiful chestnut-brown, pedicels short.

De Cand. Flor. franç II. p. 221 Schröt. Pilz. Schles. p. 345.

Puc. granulata DeBary. "Gardeners' Chronicle," 11 Aug., 1894, p. 135.

On red currant leaves. Rev. Dr. Keith, Dallas Manse Garden, *Forres*, 16th July, 1894.

307. *Puccinia (micropuccinia) Schœteri* Pass. Sori surrounded by a brownish violet discolouration of the leaf, large, oblong, solitary or in small clusters, covered or surrounded by the epidermis. Teleutospores subelliptical, at first golden then chestnut-brown, 40-60 × 25-27 μ, obscurely reticulate, rounded at both ends or the base at times attenuated; slightly constricted, if at all, pedicels very short, thick, hyaline, deciduous.

W. G. Smith, "Gardeners' Chronicle," 8th June, 1889, with fig.

On *Narcissus poeticus*. Rev. C. Woolley Dodd, *Malpas*.

Mr. Dodd very kindly sent me specimens. The spores were found not to germinate at once. The affected foliage was, therefore, placed on the ground near three or four plants of *Narcissus poeticus*, and secured in this position by being weighted down with stones. In due time it decayed and disappeared, but when the bulbs sent up leaves the following spring the tips of the leaves were affected by the fungus. They have produced sori of the Puccinia every year since, but on the tips only.

308. *Puccinia (Hemipuccinia) Acetosæ* Schum. Sori scattered on the leaves minute, irregularly rounded, on the stems and petioles elongated, soon naked. *Uredospores* globose, elliptical or pyriform 25-30 × 20-25 μ, aculeate, brown. *Teleutospores* oblong or subclavate, constricted, apex rounded 30-45 × 20-25 μ, slightly verrucose, chestnut brown, pedicels hyaline, rather long, slender, deciduous.

Saccardo Sylloge VII. p. 638.
Winter Pilze p. 187.

Schröt. Kryp. Flor. Schless. III. p. 389.
Uredo Acetosæ Schum. Saell. II. p. 231.
On *Rumex Acetosa*. Mr. A. W. Saunders. *Malden, Yorks*, 16th July, 1894.

**Puccinia (Heteropuccinia) Scirpi* D.C.

Ædidium Nymphæoides D.C. Epiphyllous, cups arranged without order on rounded spots or in concentric clusters scutellæform, margin scarcely projecting, entire. *Ædidiospores* angular 12-20 μ, orange yellow.

On the leaves of *Villarsia Nymphæoides* (Limnanthemum peltatum) in the "Old Bedford," *Earith*, July, 1895. C.B.P. in "Gardener's Chronicle" 27 July 1895 p. 96.

The Puccinia was found floating down the river Ouse at *King's Lynn* on 17th November, 1877, the host plant *Scirpus lacustris* having been cut out of some of its tributaries. It was not until 1894 that the teleutospores were found in situ at *Earith* in Bedfordshire. A visit the following year instantly revealed the Ædidium in profusion.

309. *Puccinia (Heteropuccinia) dispersa* Erick. Ædidiospores= Ædidium Anchusæ.

Uredospores Sori 1-1·5 mm. long scarcely 1 mm. wide scattered, not confluent epiphyllous brown; spores globose or shortly elliptical, echinulate, yellowish 20-30 μ.

Teleutospores Sori, covered by the epidermis, more or less scattered, forming more or less scattered black lines upon the under side (seldom on the upper) of the leaves. Each spore-group formed of numerous lines, each of which is surrounded by a crown of brown, curved, overarching paraphyses. Spores with short pedicels, mostly elongate clavate unsymmetrical. Spores 40-50 μ long, the breadth of the lower cell 12-15 μ, of the upper 14-20 μ; spores germinating in autumn. The promycelium is colourless.

Ædidiospores on *Lycopsis arvensis* in autumn.
Teleutospores on wheat, rye.
Eriksson and Henning record it on *Bromus arvensis* and *mollis*.

The teleutospores are with great difficulty distinguished from those of *P. glumarum*, but the uredospores are totally different, the sori of

those of *P. dispersa* being brown, scattered, and few. The promycelium spores and germ-tubes of *P. dispersa* are colourless.

310. *Puccinia glumarum* Schum.

Æcidiospores unknown.

Uredospores Sori ·5-1 mm. long by ·3-·4 mm. wide linear, on the leaves in long confluent colonies seated upon yellow discoloured spots often 70 mm. long, very destructive inside the paleæ and upon the immature kernels. Sori citron yellow. Spores spherical or shortly elliptic echinulate, yellow 25-30 μ.

Teleutospores Sori covered by the epidermis on the sheaths and stems in long fine brown or black lines, on the inner side of the paleæ more scattered. Each spore group is divided in numerous compartments, each of which is surrounded by a circle of dark brown, over-arching paraphyses. Spores shortly pedicellate, generally clavate unsymmetrical, apex flattened or with one or two bluntly pointed laternal projecting continuations. Upper cell 30-40 × 16-25 μ, lower 9-12 μ broad. Spores germinating in autumn. Contents of the promycelium yellow.

On wheat, barley, rye, and many grasses.
Synonyms. Puccinia rubigo-vera D. C. P. striæformis Westd. P. straminis Fckl.

Readily distinguished by the naked eye from *P. dispersa* while in the uredo stage from the fact that the spores are yellow, extremely abundant, and seated upon large elongated yellow spots, which often occupy half the blade. This is the early spring-rust. On the foliage it does but little harm in this country, but when it establishes itself, as it often does, in the chaff and on the wheat kernels, it seriously damages the latter.

311. *Melampsora vernalis* Niessl. Teleutospores in small, irregular, yellow brown, mostly densely crowded sori. Spores oblong or clavate unilocular, intercellular, as much as 45 μ long, yellowish brown.

Niessl, in Winter Die Pilze p. 237. Sacc. Syll. VII. p. 592.
On the leaves of *Saxifraga granulata*.
Mr. J. Taylor, *Portlethen*, Scotland, 12th June, 1890.

312. *Melampsora galii* Link. *Uredospores* sori minute, round, pustular, yellowish red, scattered or gregarious, pseudoperidia hemispherical, apex perforate, spores elliptical or ovoid 14-25 × 10-17 μ, aculeolate,

orange yellow. *Teleutospores* sori irregular, on spots of various sizes, formed in the cells of the epidermis and filling them, forming minute black confluent crusts. Spores rounded cuboid, generally longitudinally (quadrilocular-septate) attaining a length of 26 μ.

Thecospora Galii (Link) De Ton. Sacc. Syll. VII. p. 765. *M. Galii* Wint. Die Pilze p. 244. *Cæoma Galii* Link Sp. II. p. 21. *M. guttata* Schroet. *Uredo sherardiæ* Rostrup.

On *Galium verum*, 1889. Mr. H. T. Soppitt.

313. *Cæoma Ari-italici* Requ. Hypophyllous, sori generally irregular, flattened, orange yellow, without order or concentricaly arranged, often confluent. Spores round or elliptical, often subangular 15-30 × 15-20 μ verrucose, orange yellow.

Sacc. Syll. VII. p. 868. Cæoma Ari Wint. Die Pilze p. 256. Uredo Ari-italici Requ. Duby Bot. Gall. II. p. 899.

On Arum maculatum.

Mr. E. J. Tatum, near *Salisbury*, April, 1897.

314. *Schœteria delastrina* Winter. Sori bluish grey, pulverulent, developed in the fructification and seeds, spores joined in pairs, rarely in triplets, flattened at the point of contact, epispore greyish blue, irregularly verrucose 15-23 × 8-12 μ, promycelium mostly simple, ampullæform, short, rarely filiform, with lateral branches, sporidia globose at the apex of the promycelium, often in chains.

Fakenham, Norfolk, June, 1889, in the capsules of *Veronica arvensis*.

315. *Urocystis Filipendulæ* Fckl. Sori black, then torn, pulverulent, spore-masses as much as 44 mm. long, variable, central spores 1-7 μ round or angular, brown 15-25 × 10-15 μ punctate, peripheral spores irregular subglobose as much as 12 μ, often scarcely distinguishable from the central spores 6-12 μ, brown, sporidia cylindrical.

Fckl. Symb. Mycol. II. p. 12. Winter Die Pilze p. 122. Saccardo. Sylloge Vol. VII. p. 520.

On the petioles and midribs of the radical leaves of *Spiræa Filipendula*, Darnford Down, *Salisbury*, May, 1897. Mr. Tatum.

316. *Tilletia Rauwenhoffii* F. v. W. Sori irregular, black, spores globose 25-30 μ, epispore formed of two layers, the inner olive brown, the outer 3-4 μ thick hyaline areolate with widely hexagonal, scarcely prominent reticulations.

Sacc. Syll. VII. p. 484. Fisch. v. Wald. Aperçu. p. 50. Polycystis Holci West.

On the fructification of *Holcus mollis*, *Doncaster*, 17th September, 1891, at the Meeting of the Yorkshire Union.

**Onygena pilifera* Fr. This curious species occurred on the ejected pellet of an owl on *Ashwicken* Fen, 25th June, 1897. Mr. T. Petch.

317. *Xylaria longipes* Nitschke. Stroma erect or variously curved, growing on the thicker, fallen, decaying, decorticated branches, generally single, sometimes 2-3 joined at the base. Ascophore generally simple, terete, cylindrical, thick, apex very obtuse, rounded more rarely ventricose inflated, oblong, very rarely compressed, entire or bipartite, superficially reticulato-rimose, at first clay-coloured then black, ostiola small, hemispherical, prominent, nigropunctate. Stem variable in length, but always much thinner than the ascophore and attenuated, thickened and tuberose at the base, with thick, distinct or interwoven and adpressed, reddish black hairs, smooth above, plicato-rugulose, at first clay-coloured then brown. Conidiiferous hymenium greyish white, soon disappearing, conidia obovate, small 8×4-$5\ \mu$ on very short sterigmata, acrogenous. Perithecia immersed, not prominent, small, globose or compressed, crowded but uniseriate. Asci cylindrical, stipitate octosporous 80-100 × 7-8 μ (sporiferous portion). Sporidia obliquely uniseriate, ovate, unequilateral, black 11-14 × 5-6 μ.

Nitschke Pyren. Germ. p. 14. Sacc. Syll. I. p. 328.

On dead Sycamore *(Acer Pseudo-platanus)* branches, *Docking*, near *King's Lynn*, September, 1896.

This species occurred in considerable abundance and is evidently an autumnal one. It is distinct from all forms of *X. polymorpha* by reason of its much smaller perithecia. From *X. corniformis* the larger size of the sporidia and asci as well as the development of the stem and other characters separate it. The sporidia are binucleate.

Plate 2, f. 7 and 8 two specimens natural size, f. 9 section of apex of ascophore showing the small perithecia, f. 10 and 11 asci and parphyses, f. 12 binucleate sporidia.

318. *Xylaria Tulasnei* Nitschke. Apex of the club acute. Stroma growing from the ground or from rabbit's dung, simple, black, slender, filiform, flexuose or contorted, base variously thickened, sclerotiform, often just below the club, but not at the base, covered by an abundance of dense hairs, variable in length, conidiiferous hymenium grey, conidia very minute obovato-globose. Ascophore globose or greatly thickened at the base, apex sterile, acute, attenuated to a point. Perithecia prominent mammillate rather large, asci cylindrical, shortly pedicellate, octosporous, with very long, filiform, thin and septate pseudo

paraphyses. Sporidia subuniseriate, broadly ovate, very obtuse, straight, black, unicellular, surrounded by a thick hyaline, layer of mucous 24 × 12-14 μ.

Nitschke Pyren. Germ. p. 8. Sacc. Syll. I. p. 334. Xylaria pedunculata Fr. X. pedunculata f. pusilla Tul. Sel. Fung. Carp. II. p.18 t. II. f. 1-38. Rabh. Exs. No. 636.

This is a very curious Xylaria. The head seldom exceeds in size a lentil or small pea. When growing on rabbit's dung there is hardly any stem, the whole fungus consisting of a nodose, black, coriaceous excrescence. If, however, the ground in the immediate vicinity of the affected pellet be searched, the heads of other specimens will probably be found, just projecting above the earth. On digging these up it will be seen that each constitutes the terminal extremity of a pretty long stem from 1-5 or 6 cm. ($\frac{1}{2}$ to 3 inches). The upper part of the stem immediately below the ground level is densely hairy for a variable distance, in some cases for 4 or 5 mm., in others for 2 or 3 cm. The thickness of the stem varies from that of a mere thread as fine as horsehair to 2 or more mm. Sometimes it ends in what may have been a sclerotium, in others it seems to be lost in the ground. The globose head is surmounted by a sterile conical point. Mr. Broome, who found this fungus near *Bath* and communicated it to Rabenhorsts' Exsiccati (636), was of opinion that the base of the buried stems originated from and in buried pellets of rabbit dung. It occurs on heaths and is in fruit from October to February.

Pl. 2, f. 13 three specimens of X. Tulasnei natural size, the heads only were above ground, f. 14 three specimens on a pellet of rabbit's dung natural size, f. 15 section of ascophore showing the barren apex, f. 16 ascus and paraphyses, f. 17 sporidia.

319. *Philocopra discospora* Nov. sp. Perithecia semi-immersed or free, elongate-conical, black, paler below. Ostiola surrounded by a crown of rigid, straight, black, simple setæ. Upper part of the perithecia sparsely setulose, setæ simple, black, short, sometimes curved. Perithecia 400-500 × 250 μ, asci polysporous, cylindrico-fusiform, tapering at either end, sessile 130-150 × 18-20 μ, paraphyses as long as the asci, simple, hyaline, linear. Sporidia at first yellow, then dark brown, finally black, arranged without order in the asci, a little longer than wide, discoid 7-8 × 6-8 μ.

On rabbit dung, *North Wootton* Heath, January, 1899.

It differs from P. polyspora in the shape of the asci,—discoid sporidia and other points.

Pl. 2, f. 23 perithecium, f. 24 ascus and paraphyses, f. 25 sporidia.

320. *Rosellinia malacotricha* (Auersw.) Niessl. Perithecia gregarious, often densely crowded, conical or subglobose 200-300 μ in diameter, carbonaceous, surmounted by rigid, fasciculate, black hairs, ostiola smooth, shortly conical, shining. Asci octosporous, cylindrical, stipitate, apex blunt 100 × 10 μ, sporidia uniseriate, discoid or elliptical or semiorbicular 10-15 × 8-10 μ, at first binucleate, yellowish, then black brown, paraphyses guttulate, scarcely exceeding the asci in length.

Niessl Beiträge p. 36 t. v. f. 36. Saccardo Sylloge. I. p. 270. Fungi. Ital. t. 593.

On dead fir wood, West Briggs Wood, Wormegay, *King's Lynn*, 15th December, 1898.

321. *Delitschia Marchalii* Berb. and Vogl. Perithecia gregarious, very minute, subglobose, asci cylindrical, rather acute, shortly attenuated below 75-85 × 11-13 μ octosporous, paraphyses few and small, sporidia generally obliquely uniseriate, elliptical, obtuse, slightly constricted at the septa, at first hyaline then brown, surrounded by a narrow hyaline zone, not separating at the septum 10-12 × 5-6 μ.

Saccardo Syll. Vol. IX. p. 747.

On rabbit dung, *Castle Rising* Heath, 26th December, 1898.

Remarkable for its very minute sporidia.

322. *Sporormia Marchaliana* Mout. Perithecia gregarious, globose, ·5 to ·75 mm. in diameter, immersed or superficial, black; ostiola papillæform, thick and short; coriaceous though carbonaceous. Asci narrowly clavate, stipitate, octosporous, sporiferous portion 170-200 × 20-25 μ paraphyses filiform, branched, sporidia 1-3 seriate above, uniseriate below, cylindrico-fusiform, obtusely rounded at both ends, slightly curved, brown 11-13 septate, easily separating at the septa; the intermediate segments wider than long, surrounded by a layer of hyaline gelatin 60-75 × 8-10 μ.

Mouton in Bull. Soc. Roy. Bot. Belg. 1886 p. 155. Saccardo Sylloge. IX. p. 819.

On rabbit's dung, *Castle Rising* Heath, 26th December, 1898.

Plate 2, fig. 21 ascus f. 22 sporidia.

323. *Sporormia microspora* Nov. sp. Perithecia small, semi-immersed, black, globose or subconical, scattered, smooth, about 200-250 μ in diameter, ostiola inconspicuous. Asci cylindrical, octosporous, sessile, 100-120 × 10-12 μ. Paraphyses few, filiform, branched hyaline. Sporidia uniseriate, cylindrical, triseptate, pale then dark brown, con-

stricted at the septa, segments rather unequal, surrounded by a thin layer of gelatin 15 × 5 μ.

On rabbit's dung, *North Wootton* Heath, 18th January, 1899.

The form and colour of the sporidia recall those of Melanomma pulvis pyrius.

Plate 2, fig. 18 perithecium, *t.* 19 asci and paraphyses, f. 20 sporidia.

324. *Gibberella cyanogena* (Desm.) Perithecia crowded, oblong, 150-200 μ in diameter, obtusely conical then collapsing, umbilicate, plicate and verrucose, dark amethyst blue. Asci clavate, octosporous, obtuse above, sporidia fusiform oblong, sometimes straight, sometimes slightly curved, obtusely rounded at either end, subhyaline, triseptate, slightly constricted, 25-30 × 7 μ. Mycelium branched, effused, crustaceous, yellowish. Conidia sometimes solitary, sometimes cæspitose-fusiform, lunate, apiculate, 1-3 rarely 5 septate subhyaline.

Spheria Cyanogena Desm. Ann. Soc. Nat. X. 1848 p. 352. Gibberella Cyanogena Saccardo Syll. II. p. 555.

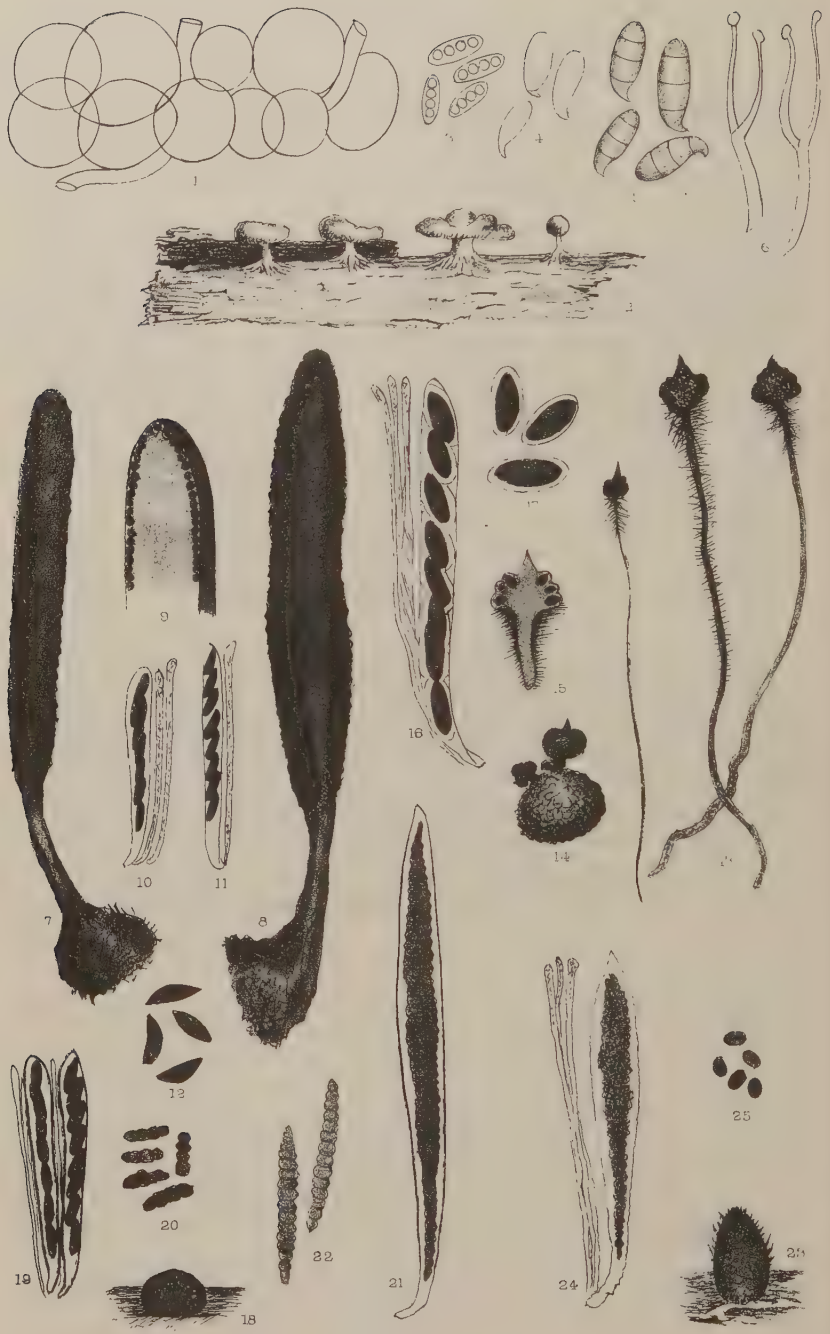
On an old cabbage stalk, Sea Bank, *King's Lynn*, December, 1898. *Halifax*, Mr. Crossland, January, 1899.

The spores are larger than those of G. pulicaris, which is found on *Sambucus*.

325. *Diaporthe (Euporthe) incrustans* Nke. Stroma effused, variable, staining the matrix. Perithecia minute, globose, rarely depressed or angular, abruptly attenuated at the neck. Ostiola elongate, often erumpent in clusters, very black. Asci narrowly clavate, octosporous, 50-65 × 7-9 μ. Sporidia biseriate or obliquely uniseriate, straight or very slightly curved, subhyaline, uniseptate, quadrinucleate 12-14 × 3 μ. Spermogonia Phoma-like spermatia 5-7 × 2-2·5 μ, basidia 30 μ long.

Nits. Pyren. Germ. p. 267. Saccardo Sylloge. II. p. 655.

Castle Rising, on cabbage stalks, 1st January, 1899.



C.B.P. ad. nat. del

West, Newman lith.

SOME CURIOUS MOULDS.

By Greenwood Pim, M.A.

While working at Fungi some curious species belonging to the Hyphomycetes and allied groups have come under my notice, to one or two of which I would like to direct the attention of the British Mycological Society.

1. *Botrytis dichotoma* Ca. This remarkable form does not appear in Cooke's Handbook, nor can I trace it in Massee; the dichotomous branching of the hyphae, with the spores dotted all over like pins in a pincushion, seems to agree exactly with the figure in Corda's Icones. It occurred in my garden at *Easton Lodge*, *Monkstown*, County *Dublin*, on a dead tulip stem.

2. *Stysanus stemonitis* Ca., var *ramosa* Pim. The interest in this consists in the fact that according to both Cooke and Massee the stem is always simple, while in the specimen in question it is repeatedly branched, each branchlet ending in the usual head of spores.

3. *Pimina parasitica* Grove.

Some years ago when examining a specimen of *Polyactis* growing on decayed leaves of Passiflora princeps, I noticed a curious black mould parasitic on the *Polyactis*. Being unable to determine it, I sent specimens to Mr. W. B. Grove, who considered it a new genus and species, for which he suggested the name of Pimina parasitica. Till quite recently I believed it was undescribed, but I have discovered that he described it under that name in the "Journal of Botany" (Vol. XXVI.) for July, 1888, p. 206, as follows:—

"*Pimina*. Sterile hyphæ creeping, hyaline, or somewhat "coloured; fertile erect, dark, crowned above with basidia; "conidia simple, hyaline, acrogenous. A genus closely allied to "*Stachylidium* of Fuckel, but distinct in habit.

"*P. parasitica.* Sterile hyphæ long, flexuous, very slender, "here and there septate, and coloured between the septa. Fertile "hyphæ short arising from the coloured part, clavate formed of "twin cells, the inferior cylindrical, olivaceous, the superior sub-"falcate, clavate, blackish; apex crowned with oblong-ovate "sterigmata, mostly in fours. Conidia globose solitary acrogenous "5μ in diameter. Habitat, parasitic on hyphæ of Polyactis on "the under side of dry leaves of Passiflora princeps and P. "quadrangularis in Mr. Greenwood Pim's garden at *Monkstown*, "Co. *Dublin*, *Ireland*."

As the plant was overlooked by Mr. Massee when dealing with the Hyphomycetes in his British Fungus Flora, and has never been figured, it seemed worth while to note it in the Transactions of the British Mycological Society, at whose meeting in *Dublin* in September 1898 it was shown by me.

Careful search has failed to discover any other specimens, so that the existing ones, so far as I know, are unique. The type has been deposited in the British Museum. Pl. 1.

Other interesting species are Papulaspora sepedonioides, Myxotrichum chartarum Kze. and M. deflexum, Berk., Helicomyces roseus, Link, Ramularia rapæ Pim, &c. A curious black mould occurred on a decaying Sapuçaya nut. It resembled Aspergillus very strongly, but differed in having the strings of spores, attached to very delicate hyphæ depending from the columella. It was described in Proc. R. I. Acad., 1883, as Alliaspora Sapuçayæ, Pim.

In conclusion I may mention a remarkable plant, though not a Hyphomycete, that I discovered on grass in a silo at *Glasnevin* Model Farm and which was described by me in the Gardeners' Chronicle for 22nd December 1883. Mr. Worthington G. Smith described it in his "Diseases of Field and Garden Crops," p. 68, as Saprolegnia philomukes as it was parasitic on Isaria fuciformis and partook of the bright red color of the host.

TWO SCLEROTIA DISEASES OF POTATOES.

By Professor E. J. McWeeney, M.D.

The sclerotium disease of potatoes is a malady which is very widespread in certain districts, especially along the western and northwestern seaboard of Ireland. This disease assumes two distinct forms —one characterised by large, compact fungal masses (the sclerotia), hanging loosely in the pith cavity of the affected potatoe plant; the other by small crumpled, inconspicuous sclerotia, firmly adherent to the outside skin (epidermis) of the leaves and stem. On planting the sclerotia belonging to the first named species they gave rise to one or several upright stalks, each supporting a small brown disc-like structure called technically *Sclerotinia sclerotiorum* Mass. This was usually about the size of a threepenny piece. On the upper surface of this were numerous oval bags called "asci," each containing eight spores. If planted on a potato these spores gave rise to threads, which penetrated into the plant, and produced after a while tuft-like masses of mycelium, the central part of which became hard and black—in other words, became a sclerotium. The affected plants soon die. This is a totally different disease to "blight," and requires different treatment. The other (smaller) variety of sclerotium when planted produces, not a peziza, but a mouse-gray mouldy growth called "*Botrytis*." This mould seems to be capable of attacking living potato plants. After killing them it produces its minute sclerotia on their withering stems and leaves. It never develops into a peziza, nor does the other peziza producing sclerotium ever produce a botrytis. By these studies, mostly carried on in the laboratory at the Albert Model Farm, the existence of two separate diseases of the potato, both characterised by sclerotia, and both eminently preventible has been demonstrated. The proper course to take is to carefully destroy by fire the withered remains of the potato crop each autumn, and not to grow potatoes on the same plot for several consecutive seasons. Deep cultivation also, with a view of burying the sclerotia out of harm's way, is very advisable. Though neither of these diseases is so much to be dreaded as the "blight," yet in certain districts they do a great deal of damage to the crop.

BRITISH MYCOLOGY.

By Miss Annie Lorrain Smith.

Mortierella Rostafinskii Bref. Untersuch. IV., p. 81.

Sporangiophores single, upright, unbranched, non-septate, cylindrical, from a swollen base which is enveloped in thread-like, septate, rhizoids, sharply constricted beneath the sporangium, colourless; sporangia globose, many-spored with a turned down, basal collar; spores globose-elliptical $6\mu \times 5\mu$ smooth, colourless; zygospores globose, 1 mm. in diameter, with a thick pale yellow, smooth epispore surrounded by an envelope of brown hyphæ—the carposporium.

In this species the zygospore acts as reserve material, the sporangiophores grow out from the envelope.

On a dead fir stump at *Strathpeffer*, *Ross-shire*, Aug., 1896, Mr. Jenkin. Journ. Bot., Jan., 1897.

Mortierella repens A. L. Sm. Journ. Bot., May, 1898.

Mycelium creeping, widely spread; sporangiophores rising from the mycelium, unbranched, slender, slightly tapering, very variable in length; sporangia globose, varying in size from 20μ in diameter without any basal collar; spores few, from five upwards, globose, 11μ in diameter.

Collected by Mr. Jenkin on damp earth, *Newport*, *Monmouth*, Jan., 1897.

M. Bainieri Cost. var. nov. *Jenkini* A. L. Sm.

Sporangiophores about 1 mm. in height, branching in a sympodial manner, tapering from 10μ in width towards the base to 5μ below the sporangium, not constricted, and without basal collar; sporangia spherical, about 25μ in diameter; spores numerous, exceedingly minute, elliptical, $3 \times 2\mu$, colourless.

Collected by Mr. Jenkin on damp earth at *Newport*, Jan., 1897.

Piptocephalis cylindrospora Bainier. Ann. Sci. Nat., Series 6, Vol. XV., p. 92.

Conidiophores without rhizoids at the base, upright, delicate, several times forked, the branches becoming always shorter, at first white, later brownish and septate; basal cell of the conidia globose, small, the upper half dotted with small projections on which are borne the conidial chains; conidia cylindrical, small $2\mu \times 4\mu$, colourless. Zygospores unknown.

On a patch of earth and moss, along with *Syncephalis*. *Newport*, Mr. Jenkin. Journ. Bot., Jan., 1897, p. 7.

Syncephalis Cornu Van Tiegh and Le Mon.

Conidiophores single, unbranched, colourless, continuous with overlapping rhizoids, the swollen top bent over; basal cell of the conidia on the apex of the swollen tip, fusiform, bearing a chain of 4-6 conidia; conidia fusiform or elliptical $10\text{-}12\mu \times 4\text{-}6\mu$, smooth, yellowish; zygospores occurring singly, globose, with a thick, yellow-brown, warted epispore, surrounded by short swollen outgrowths from neighbouring hyphæ; stylospores globose echinulate 16μ in diameter, on short stalks; chlamydospores terminal and intercalary, globose, 21μ in diameter, beset with blunt spines 6μ in length.

On a patch of earth and moss. *Newport*, Mr. Jenkin. Journ. Bot., Jan., 1897.

Leptolegnia caudata De Bary, Bot. Zeit., 1888, p. 609.

Forming dense tufts of slender, loose hyphæ, which are unbranched and blunt at the ends, the superficial hyphæ are branched and thicker. Zoosporangia elongate-cylindrical; oogonia on short side branches at the base of the primary hyphæ, usually somewhat ovate, smooth; antheridia always one or two present, obliquely clavate, diclinous; oospores single, filling the whole oogonium.

Bandon, Co. *Cork*. Allan P. Swan, F.L.S. Irish Naturalist, Vol. VII., No. 2, p. 29, Feb., 1898.

L. bandoniensis Swan, Irish Naturalist, Vol. vii., No. 2, p. 32.

Filaments sinuous and not much branched, $12\mu\text{–}14\mu$ in diameter. Sexual organs produced first, the oogonia globular,

borne at the end of long robust branches; antheridia diclinous, stout, dark; oospores globular from 5 to 20 in the oogonium, usually however about 10 in number, 20μ in diameter. Zoosporangia produced later, filamentous, the zoospores escaping by a narrow beak-like opening at the apex. Chlamydospores in large numbers, mostly developed on stout lateral branches.

Beyond telling us that these two species were found at *Bandon*, Mr. Swan has not indicated their habitat, although he mentions that there is probably no open water in *Ireland* without *Saprolegniaceae*. One of the distinctive generic characters of *Leptolegnia* is the occurrence of but one oosphere in the oogonium. Mr. Swan has placed his new species, which numbers many oospheres in *Leptolegnia*, without explaining his grounds for doing so, or without emending the genus, which would be necessary in order to include *L. bandoniensis*. Mr. Swan considers that the unusual production of chlamydospores is probably due to the conditions of culture.

Achlya apiculata De Bary, Bot. Zeit., 1888, p. 635.

Hyphæ stout 40-60μ in diameter; sporangia terminal; oogonia single, at the end of short, often bent branchlets 12μ thick, which rise in a crowded manner from the main hyphæ, elongate-ovate, ending in a sharp point, varying in size from 65μ to 75μ broad and 105μ in length, smooth with few oospores; antheridia always present, often more than one to each oogonium, borne on slender branches which rise from the main hyphæ near to the oogonial branch; oospores mostly 3-4, globose 35-50μ in diameter, smooth.

On the mouths of *Utricularia* bladders. *Strathpeffer*, *Ross-shire*, Aug., 1896. Mr. Jenkin. Journ. Bot., Jan., 1897.

Sepedonium sepedonioides A. L. Sm. *Monosporium sepedonioides*, Harz. Hyph., p. 18.

Effused rosy-white; sterile hyphæ creeping, continuous filiform, with here and there short fertile branches, umbellately branched at the tips; conidia acrogenous, globose, minutely muricate, rose coloured or rarely white 10-11μ in diameter.

Found by Mr. Jenkin, *Newport*, growing on damp cardboard.

Sporotrichum globuliferum Speg. Fung. Argent., Pug. II., p. 42.

Tufts large, 1·5 mm. in diameter, white, woolly floccose; hyphæ creeping, sparsely septate, hyaline, 3-4μ thick, branched

and anastomosing; conidia minute, globose or globose-elliptical, hyaline, 2-2·5μ × 1·5-2μ, densely crowded on the branches in small groups.

Found by Mr. Pycraft on the flesh of dead birds from *America*, with which it was doubtless introduced. Hitherto recorded on the decaying bodies of *Coleoptera* in *N. America*.

Botrytis angularis A. L. Sm. Journ. Bot., May, 1898.

Conidiophores unbranched, pale yellowish, the tip angularly swollen, and producing from the angles swollen bladder-like cells measuring 15 × 10μ, the stalks continuing to grow and form other heads; spores elliptical-oblong, 10 × 6μ, borne on very small projections on the swollen cells.

On damp moss and earth. Mr. Jenkin, *Newport*, Feb., 1897.

Acrostalagmus albus Preuss. Linnæa, 1851, p. 126.

Tufts effused, slender, somewhat woolly, white; sterile hyphæ creeping, continuous or spuriously septate, not much branched; fertile branches ascending or creeping, branched above in a verticillate manner; branchlets slightly curved, attenuated towards the tips; conidia borne in a spherical head on the tips of the branchlets soon falling off, very small, elliptical-oblong 3 × 1-2μ colourless.

On stalks of *Bryonia dioica*. *Cambridge*, Nov., 1896. Journ. Bot., Jan., 1897, p. 8.

Periconia pycnospora Fres., Beitr., p. 20, t. IV., figs. 1-9.

Fertile hyphæ gregarious, erect, rigid, sooty-brown, 200-300μ × 10-14μ, unbranched with few septa, paler upwards; conidia borne at the apex, at first in chains, sessile, brown, muriculate 12-17μ in diameter.

On dead herbaceous leaves. *Annan*, *Dumfriesshire*, Aug., 1896. Journ. Bot., Jan., 1897, p. 8.

Humaria Roumegueri Sacc. Peziza Roumegueri Karst., Grev. VII., p. 64.

Gregarious, sessile, fleshy, orbicular, margin distinct, thin and membranaceous, paler than the orange yellow disc; asci cylindrical, 8-spored; spores in one row, fusoid-oblong, smooth, colourless 24-27 × 9μ paraphyses curved, clavate at the apex filled with orange granules.

Growing on peaty ground in an old quarry at *Crimple*, near *Harrogate*. The species is new to Britain, only the variety *carnosissimus* Phil. having previously been met with.

Llewellyn J. Cocks, Godolphin House, *Harrogate*, 20th March, 1898. Naturalist, April, 1898, p. 104.

Mollisia chionea Mass. & Crossl. Journ. Bot., 1896, p. 154, Pl. 357, figs. 21-24.

Gregarious or crowded, sessile, but attached by a somewhat narrow base; thin and fragile, snow-white, almost translucent when moist, becoming dead-white when dry; subglobose and closed when young, gradually becoming plane, and finally slightly convex; margin minutely fimbriate externally, very delicately pruinose, about 1 mm. across; cortex composed of hexagonal cells, which are slightly elongated in the direction from base to margin, 20-25 × 10-12μ, running out into crowded parallel hyphæ of different lengths to form the irregularly fimbriate margin; asci cylindric-clavate, apex narrowed, base rather short, 40-45 × 5-6μ, 8-spored; spores irregularly 2-seriate, hyaline, continuous, smooth, narrowly cylindric-oblong, ends obtuse, straight or very slightly curved, 6-8 × 1·5-2μ; paraphyses cylindrical, about 2μ thick, scarce.

On dead or dying stems of *Carex pendula*. *Elland, West Yorks.* Coll. W. Needham, Oct., 1894.

Bearing some superficial resemblance to *Helotium eburneum*, which sometimes occurs on the same host, but distinguished by its larger size, absence of stem, much larger cortical cells, and somewhat larger spores. Substance soft and watery when growing.

Dasyscypha trabinelloides Mass. *Helotium trabinelloides* Rehm. Ascom. No. 853.

Gregarious or sometimes crowded sessile, at first globose and closed, then expanding, becoming again contracted when dry, entirely orange-coloured, 0·5-1·5 mm. diameter; substance thin and soft excipulum formed of radiately parallel, septate hyphæ about 4-5μ thick; externally pubescent, the hairs often arranged in groups, septate, cylindrical, obtuse, minutely rough, overtopping the entire margin and giving it a fringed appearance when seen from the outside, 50-75 × 4-5μ; asci narrowly clavate, apex slightly narrowed, 60-70 × 7-8μ; spores 8, irregularly

biseriate, hyaline, smooth, straight or very slightly curved, oblong-fusiform, 1-septate, not at all constricted at the septum, 10-15 × 3-4μ; paraphyses filiform, sometimes branched, containing orange oil-globules.

On dry decorticated beech wood. *Gomshall, Surrey.* Found on the same matrix in *Hungary* and on decaying wood of *Castanea* in the *United States.* Journ. Bot., April, 1896.

Stictis stellata Wallr. Fl. Crypt, p. 144.

Ascophore immersed, then erumpent, sessile, orbicular, small, with a black covering, then opening and shewing a horn-coloured concave disc; the outer covering furfuraceous, grumous, dirty-white, splitting in 4-6 stellate divisions at the reflexed margin; asci cylindrical 8-spored; spores fusiform, septate, colourless, 150-200 × 1·5μ.

On dead stems of *Eupatorium cannabinum. West Kilbride,* Nov., 1893. Mr. D. A. Boyd.

Pseudophacidium Callunæ Karst.

Subgregarious, erumpent, subspherical, breaking from the centre in 4 somewhat triangular laciniæ, black with a pallid disc, about 1 mm. in diameter; asci clavate 62-95 × 10-12μ; spores elliptical or oblong elliptical, eguttulate, continuous, colourless, 9-17 × 4-6μ.

On dead branches of *Calluna vulgaris. West Kilbride,* March, 1892. Mr. D. A. Boyd. Journ. Bot., May, 1898.

Lizonia de Not. Sferiæ. italici, p. 72.

Perithecia crowded superficial smooth of almost leathery consistence; spores 8 oblong, 2-celled, brownish.

Lizonia emperigonia de Not.

Perithecia in rows or small groups on the upper surface of the antheridial leaves of moss, attached by creeping brown hyphæ, ovate, blunt at the apex or with a small papilla, black, 250-300μ in diameter; asci clavate or oblong-cylindrical, shortly stalked 135μ × 18μ; spores in two rows oblong or oblong-fusiform, mostly unequal-sided, 1-septate slightly constricted 30-46μ × 10-15μ.

On the flower-heads of *Polytrichum commune.* Found by Mr.

Lloyd Williams on material in the laboratory of the Pharmaceutical Society. Journ. Bot., Jan., 1897.

Thyrsidium Hedericolum Dur. and Mont.

Pustules gregarious, globose-depressed, black, covered by the epidermis, the contents flowing out in a granular looking tremelloid mass; spores minute, globose, 3μ in diameter, olivaceous, densely aggregated into subspherical heads; borne on forked or branched filiform sporophores.

On *Hedera Helix*.
Var. *Carpini*. On branches of *Carpinus Betulus*. *West Kilbride*, July, 1897. Mr. D. A. Boyd, Journ. Bot., May, 1898.

Clavaria Kewensis Mass. Journ. Bot., April, 1896.

Base thick, dividing almost at once into numerous, subequal divergent branches 4-7 cm. long; branches uniform in thickness throughout, often compressed, imperfectly hollow, dividing near the apex into 2-4 short branchlets, axils rounded, tips obtuse or divided into 2-4 short finger-like processes; base and main branches rusty-brown, becoming ochraceous upwards, pruinose with the elliptical, colourless spores, which measure 5-6 × 3·5-4μ. Fragrant.

On rotten wood. Rock Garden, *Kew* Gardens, Oct., 1896. Forming dense tufts 5-6 in. across. A very distinct species, characterized by the rusty colour, and fragrant, spicy smell, which resembles that of *Lentinus cochleatus*.

Coprinus stellaris Quél.

Pileus ovoid, then campanulate, striate, snow-white, then greyish, *crowned with minute pellucid vesicles* 1-2 mm. across. Gills adnate, spores elliptical, about 8μ long, stem 1-2 cm. long, filiform, hyaline, velvety with slender white hairs. *Swarraton, Hants.*

Underneath side of loose clods of cow dung, in pastures. *Swarraton*, Rev. W. L. W. Eyre.

The hairs average about 45 × 10μ. The French specimens usually found in caves.

Panus rudis Fr.

Caespitose. Pileus 10 cm. across, fleshy, coriaceous, then corky, thin, unequal, excentric or dimidiate, ochraceous fawn or reddish,

margin incurved lilac and *bristling with hairs as is also the stem.* Stem short, unequal, ochraceous fawn, shaggy, with a rough haired *velvet, lilac.* Gills very decurrent, narrow, whitish pink, then pale ochraceous fawn, as is the whole fungus. Flesh white. Smell, pleasant of anise. Spores, 5-6 × 3μ, cylindrical, hyaline. On beech, *South Elkington, Lincolnshire,* May, 1895, J. B. Robinson. Distinguished by the velvety hairs on the margin of the pileus and stem.

RECENT OBSERVATIONS OF PROFESSOR ERIKSSON ON THE RUSTS OF OUR CEREALS.

By C. B. Plowright, M.D.

Since 1890. Professor Eriksson has been working experimentally on the life-history of the fungi which cause the various rusts of our cereal crops. In July of last year he delivered a lecture at Stockholm to the Scandinavian Congress of Agriculturists, in which he epitomised his nine years' work. In 1894 he, in association with Dr. Ernest Henning, published that large volume, *Die Getreideroste*, in which the authors showed that the mildew of Wheat meant a great deal more than simply Puccinia graminis with its æcidiospores on the Barberry. Continued observations have confirmed and amplified the results then obtained. Prior to the appearance of this work the cereal rusts were regarded as being due to three Pucciniæ, viz.—P. graminis P. with its æcidiospores on Barberry; P. rubigo-vera D. C., with its æcidiospores on Anchusa; P. coronata Corda, with its æcidiospores on Rhamnus. The authors found that P. graminis was divisible into two species—(1) the true P. graminis, with its æcidiospores on Barberry; (2) P. Phlei-pratensis E. & H., which occurs on P. pratense, and Festuca elatior with unknown æcidiospores. But more than this, they found that P. graminis occurs in six biologically distinct forms on Rye, Oat, Wheat, Aira, Agrostis, and Poa, which they call Forma Secalis, Avenæ, Tritici, Airæ, Agrostidis, and Poæ. Now these specialized forms, or varieties or sub-species, call them what you like, have this in common—that they all have their æcidiospores upon the Barberry; but the æcidiospores formed, let us say, from Forma Secalis on Rye, will not, when placed on Oat, or Wheat, or Poa, or Aira, or Agrostis, give rise to the uredo, but when placed on Rye they will do so. Nor will the uredospores from Rye give rise to the uredo on any of the above-named grasses. Let us go a little further: there is a certain group of grasses to which Forma Secalis is confined, this includes not only Rye, but also Barley, Twitch, Elymus arenarius, and Bromus secalinus, and to these (with one or two closely allied species, *e.g.*, Hordeum jubatum, Triticum caninum and desertorum), it is confined. The next form, Avenæ, is confined to the Oat, Avena elatior, sterilis, Dactylis glomerata, Alopecurus pratensis, Milium effusum, Lamarckia aurea, and Triosteum distichophyllum.

Far and away the most important to us, however, is the form on Wheat, which is confined to Wheat, and does not even go to Triticum repens. The importance of this fact is obvious, for in the first place there is no fear of Wheat mildewing adjacent fields of Barley, or Rye, or Oats, or being mildewed by them; nor, in the second place, is there any fear of the Wheat catching the disease from mildewed grasses in the hedge-banks, &c. Bear in mind that, although these six forms are morphologically indistinguishable, either in their æcidiospore, uredospore, or teleutospore stage, yet they are biologically distinct. Briefly, we have to deal with a form on Wheat, another on Oats, and a third common to Oats, Barley, Rye and Twitch, the other three forms being of botanical interest only.

In the same way the authors found that P. rubigo-vera D.C., was divisible into three good species, viz., P. glumarum Sch.; P. dispersa E. & H.; and P. simplex Korn. Let us say a word or two about these *seriatim*.

P. glumarum (Schmidt), the yellow rust or spring rust, as we often call it in *England*, possesses well-marked characters in its uredo stage, by which it can be recognised with the naked eye, inasmuch as the minute uredospore-beds occur on large elongated yellow patches on the leaves. The teleutospores are scanty in proportion to the uredo, and the sori minute.

This rust owes its chief interest to two things: First, its great abundance and its conspicuousness alarm the Wheat-grower, making him think that his crop is going to be "mildewed," whereas, in reality, it rarely causes any appreciable diminution of the yield. Secondly, because it has the habit of sometimes developing its uredospores upon the chaff (Cosh) of the affected Wheat-plants, hence its specific name —Uredo glumarum. When this happens, it does injure the crop, because the uredospores spread from the chaff to the kernels themselves, causing them to be distorted, and more or less abortive. On many of these damaged kernels one can find spore-beds of the teleutospores when the grain reaches maturity.

In a similar manner, P. glumarum is met with in five specialised forms, viz., Tritici, Secalis, Hordei, Elymi, and Agropyri, on Wheat, Rye, Barley, Elymus, and Triticum repens respectively.

Puccinia dispersa E. & H.—The brown rust is not nearly so conspicuous, nor is it so abundant as P. glumarum. It is met with later in the season in *England*, not long before harvest. The uredo sori are like immature spore-beds of the uredo of P. graminis, only they

are very much smaller. The teleutospores are so like those of P. glumarum as to be only distinguished with difficulty. It has its æcidiospores on Anchusa in autumn, those of P. glumarum being unknown. P. dispersa has four forms—on (1) Rye, (2) Wheat, (3) Twitch, and (4) on the Bromi.

Puccinia simplex (a species first described by Kornicke) has been known for many years. It is confined to Barley, and is common in *England*; it is easily recognised by the large number of its teleutospores, which have one cell abortive.

Secondly, there are the crown rusts, P. coronata and coronifera, whose life-history has been worked out by Klebahn. The former has its æcidiospores upon Rhamnus frangula, and is met with in five forms, according to Eriksson, viz., 1, Calamagrostidis; 2, Phalaridis; 3, Agrostidis; 4, Agropyri; 5, Holci. The latter (P. coronifera) has its æcidiospores on R. catharticus, and occurs in 6 specialised forms, viz., 1, Avenæ; 2, Alopecuri; 3, Festucæ; 4, Lolii; 5, Glyceriæ; 6, Holci.

Eriksson draws attention to the fact that the extension of rust (uredo) from plant to plant is after all usually confined to a few yards. For instance, P. graminis on Twitch is one of the commonest forms in *Sweden*, as it is in *England*; if one searches in the vicinity of a Barberry-bush, one is almost sure to meet with it, but the affected plants are not found many yards from the bush. This form, it will be remembered, also occurs on Barley and on Rye, but although it is common enough on Twitch it seldom spreads, and then only to a limited extent to the above-named cereals. A further instance, showing how limited these uredospores often are, is given, which occurred at the experimental station at Stockholm in 1894, where a plot of Horsford's Pearl, a variety of Wheat specially liable to P. glumarum, was grown between five other varieties. On the Horsford the characteristic uredo first showed itself on May 11th, and in forty-three days had attained its maximum, but at the end of that period only three of the surrounding plots showed any signs of this rust, and these only to a very slight degree.

The germinating power, both of the uredo and of the æcidiospores, is often but small and at best capricious. Eriksson considered, upon reflection, that since Roman times, hot days and cold nights have been considered favourable to mildew, he resolved to try the effect of placing these spores upon ice for some hours, and by doing this he succeeded in arousing them to germination. The distance to which the æcidiospores are capable of spreading the fungus from an individual æcidial

host-plant he considers has been greatly over estimated. Julius Kühn in 1875 thought 100 mètres (120 yards) might be considered the limit, but Eriksson puts it at from 10 to 25 mètres (12 to 30 yards). The dissemination of the mildew in India, for instance, where the nearest Barberry is 300 miles away, on the Himalayas, cannot be effected by the æcidiospores. He found, too, that in *Sweden* the uredo on Triticum repens, beneath a Barberry-bush, sometimes appears before the æcidiospores on that bush ; or at any rate, before it had time to originate fron the æcidiospores. Further, the teleutospores on P. graminis are capable of germination in spring only, and then only after they have been exposed to the vicissitudes of the previous winter, hence mildewed straw kept in a barn or in a stack is not dangerous. Further, he finds that it is those teleutospores only which have been developed in late autumn that are capable of germinating next spring.

Let us recapitulate these statements :—

1. That there are a multiplicity of different spore forms capable of affecting certain special host plants only.

2. That the uredo and æcidiospores exhibit a certain degree of obstinacy and capriciousness in germination.

3. The short distance they are capable of extending the fungus.

4. The fact that the uredo has been observed before the æcidiospores.

5. The limited germinative faculty of the teleutospores.

Taking into consideration the above facts, it is improbable that the general dissemination of rust takes place in the usually accepted manner, viz., from separate centres and by geometric progression.

In *Sweden* the dominant rust is Puccinia glumarum, and this form Eriksson has made the subject of special study, with the particular object of elucidating this question. In the first place he noticed that the uredospores in spring appeared on the young plants of certain varieties four or five weeks after the Wheat had been sown. and in the second place that sunniest parts of the fields were sometimes worse affected than the shady. These observations induced him to try the following experiment : young plants immediately after the melting of the snow in spring, were enclosed in wide glass tubes carefully packed at both ends with cotton-wool. In from six to eight weeks Uredo glumarum appeared upon them. It is possible that this may have resulted from an infection in autumn, although it is not probable for one would have *cæteris paribus* expected had this been the case that the uredo would have shown itself sooner. He therefore sowed

seeds of a variety of Barley extremely susceptible to yellow rust in sterilized soil, and properly protected from external infection, yet even then a certain proportion became rusted. He therefore concludes that the fungus arose from "internal germs inherited from the parent plant," which can only be detected just before the eruption of the young pustules. Hence, the fungus lives for a long time a latent symbiotic life as a mycoplasma in the cells of the embryo, and only assumes the visible form of mycelium just before the eruption of the sori. Therefore the severity of an attack of rust (or mildew) depends: (1) On the external surroundings, the environment of the plant, the weather, the soil, manuring, &c.; if these conditions be favourable, the latent mycoplasm ceases its symbiotic existence and develops into mycelium and spores. (2) On the accession of external infective material, i. e., spores from without. The mycoplasmic symbiosis of P. glumarum is more energetic in such varieties as Horsford's Pearl, which is especially liable to this rust than in Squarehead, which is practically exempt, because the symbiotic existence of the parasite with this variety is so languid as to be practically non-existent.

Table of Eriksson's Spore-forms of the Pucciniæ of the Cereals.

Puccinia graminis P. (Æc. berberidis)	1 Secalis	On Rye, Barley Twitch, &c.
	2 Avenæ	on Oat, Avena sp. Dactylis, Alopecurus, &c.
	3 Tritici	on Wheat.
	4 Airæ	on A. cæspitosa.
	5 Agrostidis	on A. vulgaris, &c.
	6 Poæ	on P. compressa,&c.
P. Phlei-pratensis E. & H.	- - -	on P. pratense, Festuca elatior.
P. glumarum Sch,	1 Tritici	on Wheat
	2 Secalis	on Rye.
	3 Hordei	on Barley.
	4 Elymi	on E. arenarius.
	5 Agropyri	on Triticum repens.
P. dispersa E. & H. (Æc. Anchusæ)	1 Secalis	on Rye.
	2 Tritici	on Wheat.
	3 Agropyri	on T. repens.
	4 Bromi	on B. arvensis, &c.

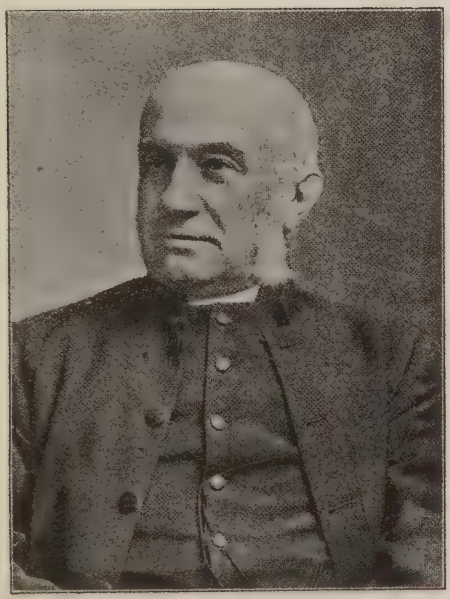
P. simplex Körn. - - - -		on Barley.
P. coronifera Kleb. (Æc. Cathartici)	1 Avenæ	on Oat.
	2 Alopecuri	on A. pratensis, &c.
	3 Festucæ	on F. elatior.
	4 Lolii	on L. perenne
	5 Glyceriæ	on G. aquatica
	6 Holci	on H. lanatus and H. mollis
P. coronata Corda. (Æc. Frangulæ)	1 Calamagrostidis	on C. arundinacea.
	2 Phalaridis	on P. arundinacea.
	3 Agrostidis	on A. vulgaris, &c.
	4 Agropyri	on T. repens.
	5 Holci	on H. mollis and lanatus

REV. CANON DU PORT.

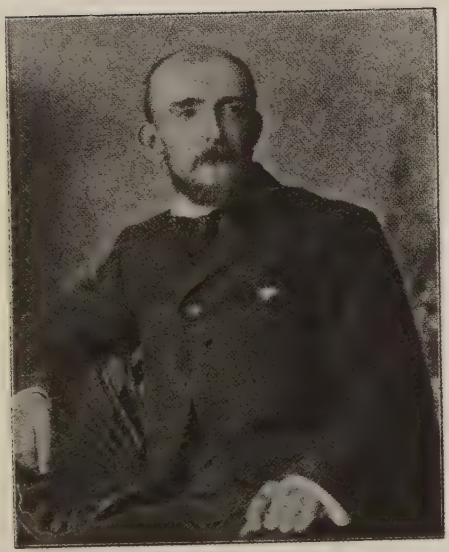
Another of the older generation of British Mycologists has passed away in the person of the Rev. Canon Du Port, who died at *Denver* Rectory, in the County of *Norfolk*, on 21st February, 1899. James Mourant Du Port, the son of James Du Port, Assistant Treasurer of the States of *Guernsey*, was born at *St. Peter's Port* on 14th April, 1832. He was educated at Elizabeth College, from whence he obtained a scholarship at Caius College, *Cambridge*. He took his B.A. in 1855, being tenth wrangler and subsequently became Dean of his College. He was Hebrew Lecturer from 1855 to 1862. In the latter year he was appointed to the vicarage at *Mattishall*, where he remained till 1884, when he became Rector of *Denver*. In 1881 he was made Honorary Canon of *Norwich* and in 1890 Rural Dean. Throughout his life he was keenly interested in Natural Science. For a long series of years he conducted meteorological observations both at *Mattishall* and *Denver*. His greatest pleasure, however, was in the study of botany. Not only did he possess a sound practical knowledge of the phanerogams of his own country, but also the floras of *France* and *Switzerland*, as well as that of *Egypt*, received his attention. He was best known however as a fungologist, and for many years was a regular attendant at the Fungus Forays of the Woolhope Club, of which Field Club he was an honorary member. His knowledge of Latin was greatly appreciated by his fellow-members, and it was always at their service, for he spared no trouble in unravelling the intricacies of the descriptions of the "*Hymenomycetes*" and "*Monographia*." Always ready to help, his genial manner and kindheartedness made him a universal favourite amongst the Woolhopians. For many years he was a member of the Société Mycologique de France, and attended several of the forays, notably in 1887, 1891 and 1896, where his knowledge of the French language stood him in good stead, for he was as much appreciated there as here. Mainly interested in the Hymenomycetes there was nothing in the shape of a fungus which came amiss to him. One of the species found by him at *Mattishall—Russula Du Portii*—was named after him; it is figured in Cooke's Illustrations, pl. 1,042.

He contributed the following papers:—

"On some species of Tricholoma not easily distinguished," Wool. Trans., 1883.



THE LATE REV. CANON DU PORT.



THE LATE MR. H. T. SOPPITT.

"On the colours of the fungi as indicated by the Latin words used by Fries," Ib., p. 113.

"The unexpected appearance of two species of fungi in a field quite recently under cultivation," Ib. 1890, p. 122.

"On the Fungoid diseases of Cereals," Norf. and Norw., Trans· 1880, p. 194.

"On some of the rarer fungi found near *Mattishall* in 1880," Ib., p. 200.

"On a remarkable appearance of fungi," Ib. 1893, p. 558.

Many sorrowing friends attended the funeral, amongst whom were the Bishops of Norwich and Thetford and our President, Dr. C. B. Plowright, his medical attendant.

MR. H. T. SOPPITT.

On April 1st, 1899, died at his residence, 12, Glen View, *Halifax*, Henry Thomas Soppitt, who succumbed, after an illness of a fortnight, to an attack of pneumonia. Born in *Bradford*, June 21st, 1858, he was only in his 41st year when he was taken from us, leaving the world poorer by the loss of an original worker in that department of natural science in which he had made for himself a name. The subject of the present notice possessed that untiring energy and never flagging perseverance which are so essential to those who would unravel the secrets of Nature. A Yorkshireman by birth, he possessed the genial *bonhomie* and warm-heartedness of his race, tempered by a natural diffidence of manner that made it impossible for him to hurt the feelings of anyone. Brought up in his father's business, he resided in *Bradford* until 1894, when he removed to *Halifax*. Compelled to earn his living by an uncongenial and poorly-remunerative occupation, he managed to acquire an all-round knowledge of natural history; entomology, geology, zoology, and botany were alike to him the objects of study and the sources of enjoyment. Devoid of personal jealousy, and ever free to impart the information he possessed to others, it is no wonder he made many friends.

Fond as he was of all branches of natural history, it was as a botanist that he did his most brilliant work. Possessing a sound knowledge of the flowering plants of *Yorkshire*, he took a special interest in fungi. Some ten or twelve years ago he began the biological study of the Uredineæ, and it is from his experimental researches that we know the life-history of the several species which had previously either been shrouded in mystery or wrongly interpreted. For instance, prior to his work, the Puccinia and Æcidium on Adoxa Moschatellina

were regarded as being stages of the same species, but he demonstrated that the Puccinia is a Micropuccinia, and has no relation to Puccinia albescens, which is an Auteupuccinia with Æcidium, Uredo, and teleutospores on the same host-plant. He then cleared up the life-history of Æcidium leucospermum, showing it to be an Endophyllum. He found its spores germinated as those of Endophyllum do, and that while they were without effect upon adult plants, yet seedling Anemones became affected with the Æcidium after infection, and that the fungus had nothing whatever to do with the Puccinia fusca which occurs on the same host-plant. It fell to his lot to be the first person to demonstrate a heterœcious Puccinia which has its Æcidiospores on a Dicotyledon; this he did in working out the life-history of P. Bistortæ, by proving that its Æcidiospores occur on Conopodium denudatum. He attacked that complicated problem, the life-history of the Pucciniæ on Phalaris arundinacea, proving that the Æcidium on Lily of the Valley belonged to one of them, which he named P. digraphidis, thereby opening a discussion amongst continental botanists as to the relative value of these specific forms, which has hardly yet been concluded. Lactarius involutus, Sopp., is figured in Cooke's *Illustrations*, t. 1,194. Dasyscypha Soppittii, Mass., is named after him, as also is the genus Soppittiella, one of the Thelephoreæ. His last paper in conjunction with Mr. Crossland appeared in the January number of the *Naturalist*, and contained descriptions of several new species of Discomycetes. He was present at the last meeting of the British Mycological Society, of which he was one of the original members, last October, in *Dublin*. He was in excellent health, enjoyed the meetings and excursions, and the meeting of old friends. From what fell from him there, it was evident that a somewhat lengthy visit to *Switzerland* in 1897, with his friend Mr. H. A. Pawson, where he found an opportunity of studying the Swiss flora, was one of the red-letter periods of his life. He was buried at *Ecclesbill* on April 4th, when most of the leading Naturalists of *Yorkshire* were present. He left a widow and four children to mourn his loss.

Mr. Soppitt wrote many interesting Botanical papers, amongst which we may enumerate—

1883—Fungus Foray of the Woolhope Club. The Naturalist, Nov., 1883, pp. 61-63.
1884—Poisonous Fungi. Gardeners' Chronicle, 15 Nov., 1884, p. 629.
1888—Yorkshire Fungus Foray. Gard. Chron., 13 Oct., 1888, p. 420.
1890—Puccinia digraphidis, Sopp. Journal of Botany, July, 1890, pp. 213-216.

1890—Lily of the Valley Fungus. Gard. Chron., 24 May, 1890, p. 643.

1891—Doncaster Fungus Foray. Naturalist, Nov., 1891, pp. 339-348.

„ —Strobilomyces strobilaceus in South-west Yorkshire. Naturalist, Dec., 1891, p. 353.

„ —Additions to West Yorkshire Fungi. Naturalist, Sep., 1891, pp. 279-282.

1892—A Mycological ramble in mid November. Naturalist, Jan., 1892, p. 16.

1893—Æcidium leucospermum D.C. Journal of Botany, Sep., 1893, pp. 273-274.

„ —Some observations on Puccinia Bistortæ Str. Grevillea, Dec., 1893, pp. 45-47.

1894—Botanical Rambles about Arnside. Naturalist, Sep., 1894, pp. 265-267.

„ —Clavaria fusiformis in Westmoreland. Naturalist, Nov., 1894, p. 348.

1897—Bermerkungen uber Puccinia Digraphidis Sopp. Zeitschrift fur Pflanzenkrankheiten, 1897. Bd. 8, p. 8.

1898—The Gooseberry Fungus Æcidium grossulariæ. Gard. Chron., 20 Aug., 1898.

1899—New British Fungi found in West Yorkshire. Naturalist, January, 1899, p. 27.

By the kindness of the Editor of "The Gardeners' Chronicle" we are enabled to place before our members the accompanying portrait.

The following Members have joined the British Mycological Society during the Season 1897-1898.

Francis Mr. George E., M.D., 79, Elm Street, Worcester, Mass., United States of America.

Gardner Mr. Fred, 11, Nevill Street, Abergavenny.

Hughes Mr. G. C., Chesterton, Bicester, Oxfordshire.

Johnson Professor T., D.Sc. Science and Art Museum, Kildare Street, Dublin.

Montague Mrs. L., Penton, Crediton, N. Devon.

Pipe Mr. Charles E., Broad Street, Worcester.

Ramsay Mr. A., 4, Cowper Road, Acton, London.

Smith Miss Annie Lorrain, of the Cryptogamic Department, Herbarium, British Museum, S. Kensington, London.

Stretton Mr. A., 17, The Tything, Worcester.

Swanton Mr. E. W., The Educational Museum, Haslemere, Surrey.

OFFICERS FOR THE SEASON 1897-1898.

President - - - George Massee, F.L.S., Royal Herbarium, Kew.

Acting President - - Charles B. Plowright, M.D., King's Lynn.

Hon. Sec. & Treasurer- Carleton Rea, B.C.L., M.A., 34, Foregate Street, Worcester.

THE NEW FOREST FORAY.

2nd–7th October 1899.

The third annual week's fungus foray was held in The New Forest, where the members assembled on the evening of Monday, the 2nd of October, at the Crown Hotel, Lyndhurst, under the Presidency of Mr. C. B. Plowright, M.D., who exhibited, on behalf of Mr. W. Phillips, F.L.S., some fine examples of *Geaster limbatus* Fr., and the Rev. W. L. W. Eyre placed out on exhibition a lovely specimen of the excellent esculent *Amanita strobiliformis* Vitt. from North Hants, where he said it was common.

On Tuesday, the 3rd of October, the members proceeded, under the conductorship of their member, the Rev. W. L. W. Eyre (who is intimately acquainted with the Forest and had kindly arranged the details of the different days' forays) to the Woodlands enclosure, where amongst the pines a good crop of fungi were found. These included *Tremellodon gelatinosum* Pers., *Rhizopogon rubescens* Tul., *Polyporus spongia* Fr., *P. amorphus* Fr., *Boletus candicans* Fr., *B. duriusculus* Schulz., *Mycena Iris* Berk., and *Lactarius theiogalus* Fr. The Club dinner was held in the evening at The Crown Hotel, after which the election of officers and other business was proceeded with. Professor H. Marshall Ward, M.A., F.R.S., F.L.S., was unanimously elected President, and Mr. Carleton Rea, B.C.L., M.A., Hon. Secretary and Treasurer. Mr. Rea reported that he had enrolled 4 new members, whilst they had lost, by death, 2 eminent members during the year, The Rev. Canon Du Port and Mr. H. T. Soppitt, and one member, Mr. J. W. Sutcliffe of Halifax, had resigned. The accounts showed an adverse balance of £3. 10s. 5d., but against that amount there were outstanding subscriptions due and unpaid of over £6, and some numbers of the *Transactions* for sale. The invitation of the Cryptogamic Society of Scotland to join their meeting next year at *Rothiemurchus* was unanimously accepted, whilst the invitations of The South Eastern Union of Scientific Societies and others were held over for further consideration at the next meeting.

On Wednesday, the 4th of October, the members explored the Forest, going through the beech woods on either side *via* Lyndhurst Hill to Allum Green, returning home by the Christchurch Road,

whilst a few members made a detour through a pine plantation. The most noticeable species included *Mycena aurantio-marginata* Fr., *Boletus aereus* Bull., *Sparassis crispa* Fr., and *Poronia punctata* Fr. In the evening Mr. C. B. Plowright, M.D., delivered his presidential address, entitled "Recent additions to our knowledge of the Uredineæ" (see p. 90). and Dr. M. C. Cooke sent a poetic welcome to his fellow-members, including a long enumeration of mycologists and their doings for some years past, which was much appreciated.

On Thursday, the 5th of October, the Rev. W. L. W. Eyre led the members again to Allum Green, and the Forest further away from Lyndhurst was explored, the members returning by the Ringwood Road, Emery Downs, to Lyndhurst, but only *Polyporus spumeus* Fr. and *Russula chamaeleontina* Fr. are worthy of note. In the evening, papers were read by Mr. Charles Crossland, F.L.S., on "Mollisia cinerea and its varieties" (see p. 106); Mr. T. Howse, F.L.S., "Notes on fungi in the Alps," and the Rev. W. L. W. Eyre, "Notes on Hampshire Fungi" (see p. 110); he also most generously distributed to the members "A list of fungi found in the County of Hants," which he had specially compiled for the use of the members of the British Mycological Society attending this Foray. The list includes over 580 species of the Basidiomycetes, and Mr. Eyre must be congratulated on the accuracy of his work, seeing that only 46 species were added to that list during the week's foray by all the members, whilst 221 species enumerated therein were confirmed.

On Friday, the 6th of October, the enclosures of Boldre Wood, Mark Ash, and Knight Wood were investigated, but time did not allow of the complete investigation of the latter. A fine specimen of *Polyporus Schweinizii* Fr. was gathered, and also many examples of *Gomphidius gracilis* Berk. and *Russula azurea* Bres.

On Saturday, the 7th of October, Knight Wood was further explored and its giant oak visited during the morning, where two rare Hydneæ were found, namely, *Hydnum Queletii* Fr. (first record for Britain) and *Hydnum cyathiforme* Schaeff., and specimens of *Poria umbrina* Fr. and *Tremellodon gelatinosum* Pers. were gathered. Many of the members had now departed home, but those remaining in the afternoon had an enjoyable drive to the picturesque ruins of Beaulieu Abbey.

List of the more uncommon fungi observed during the Foray:—

Amanita spissa Fr.
Tricholoma sejunctum Sow.
flavobrunneum Fr.
albobrunneum Pers.
imbricatum Fr.
acerbum Bull.
Collybia nitellina Fr.
ambusta Fr.
Mycena aurantiomarginata Fr.
Iris Berk.
capillaris Schum.
Entoloma lividum Bull.
Leptonia formosa Fr.
Pholiota radicosa Bull.
Stropharia squamosa Pers. var. aurantiaca Cke.
Cortinarius (Myxacium) collinitus Fr.
(Dermocybe) lepidopus Cke.
miltinus Fr.
raphanoides Pers.
(Hygrocybe) castaneus Fr.
Gomphidius roseus Fr.
gracilis Berk. & Br.
Hygrophorus cossus Fr.
miniatus Fr.
Lactarius insulsus Fr.
pallidus Fr.
theiogalus Fr.
fuliginosus Fr.
serifluus Fr.
Russula caerulea Fr.
lactea Fr. var. incarnata Quél.
azurea Bres.
consobrina Fr. var. intermedia Cke.
chamaeleontina Fr.
Lentinus cochleatus Fr.
Boletus flavidus Fr.
tenuipes Cke.
bovinus Linn.
variegatus Sow.
calopus Fr.
candicans Fr.
aereus Bull.
purpureus Fr.
duriusculus Schulz.
Polyporus Schweinizii Fr.
intybaceus Fr.
spongia Fr.
amorphus Fr.
spumeus Fr.
Fomes applanatus Wallr.
Poria umbrina Fr.
Hydnum Queletii Fr.
cyathiforme Schaeff.
Irpex obliquus Fr.
Radulum orbiculare Fr.
Grandinia granulosa Fr.
Peniophora gigantea Mass.
Coniophora sulphurea Mass.
Sparassis crispa Fr.
Calocera stricta Fr.
Tremella intumescens Eng. Bot.
Tremellodon gelatinosum Pers.
Rhizopogon rubescens Tul.
Uredo Mülleri Schröt.
Phragmidium albidum Kühn.
Orbilia luteorubella Karst.
Dasyscypha calycina Fckl.
Ciboria echinophila Sacc.
Nectria inaurata B. & Br.
Poronia punctata Fr.
Quaternaria Persoonii Tul. conidial form.
Schirrhia rimosa Fckl., Pycnidia on Arundo phragmitis.

ON THE RECENT ADDITIONS TO OUR KNOWLEDGE OF THE UREDINEÆ AND USTILAGINEÆ WITH SPECIAL REFERENCE TO THE BRITISH SPECIES.

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JUST ten years ago, a monograph of these fungi was published, but since then so many and so active have been the workers in this particular branch of study that it is essential for us to have an outline of what has been done if we would not be entirely left behind the times in matters mycological. Klebahn and Dietel in Germany, Fischer in Switzerland, Eriksson in Sweden, Rostrup in Denmark have year after year added fresh facts to our store of knowledge, while Magnus as vigorous as of yore, Hartig, Juel, Chodat, Tranzschel, Henning, Lagerheim, De Toni, Pazschke, Brefeld, Setchel, Kühn Cocconi, Richards, Swingle, Wagner, Bubak, Marshall Ward, Barclay, Jacky and others have each added their modicum. Nor are we likely to forget our friend the late Mr. H. T. Soppitt, who was with us at our last meeting and to whom we owe so much. We can but regret he was never in a position during his short but active life to have devoted his whole energies to this subject, in which case we should not have needed to have gone abroad for the elucidation of so many life histories.

These fungi constitute such an economically important group of the Basidiomycetes that it is not surprising they should have received so much attention. The remarkable character some of them possess of changing their host from one species of phanerogam to another has no doubt been the attraction to many biologists to investigate their development.

When in 1864 De Bary announced in his now classical paper that the Æcidium on barberry was but a stage in the life cycle of *Puccinia graminis* and in 1865 that *Aecidium asperifolii* and *Aec. rhamni* were similarly related to *Puccinia rubigo-vera* and *coronata* it was thought that the life-history of the cereal rusts was settled and done with and that the number of species of the Uredineæ was wonderfully reduced. One or two carping critics would however persist in pointing out that the whole matter was not cleared up quite so completely ,that for instance there were certain districts in England from which the barberry was absent but where from time to time the wheat crop was seriously injured, nay further there were countries, in some of our colonies especially, in which no barberry grew but in which more damage was done to the wheat crop than was even the case in those parts of Europe, where the shrub is comparatively common.

We now know of course both groups of facts are perfectly true, and although we are unable completely to explain every detail of either, it only remains for us to work on steadily accumulating information, piling together observations, and if we only go on long enough we shall in due time understand the whole question We got but little light on this wheat mildew problem until Eriksson in 1894 showed us that the so-called *Puccinia graminis* represents a number of biological species: all of which have their æcidiospores on the barberry but their other spore forms on certain groups of grasses. For instance the uredospores on wheat cannot be made to grow upon *Triticum repens*—although the *Triticum repens* uredospores will infect barley and rye. A keen discussion at once arose as to whether these different forms should be called species, varieties, sister-species or forms, what we decide to call them really does not matter very much. A great deal will depend upon the standpoint from which they are regarded, if from an herbarium-standpoint they are not species in as much as one can find no tangible difference in appearance, size, colour, and form of their respective spores. But judging a fungus by its spores alone is something akin to judging a flowering plant by its seed. A practical seedsman can distinguish rape from mustard or turnip seed but for all that he generally protects himself by declining to guarantee, on the label of the parcel he supplies you with, that the seed sold will produce the desired crop. On the other hand those interested in plant diseases who look at the matter from a laboratory-view-point when they find one fungus on wheat and another on *Triticum repens* which, although they are indistinguishable by the eye, yet cannot be made to interchange hosts: they naturally regard them as

distinct species. The simplest way seems to call them biological species and have done with the controversy.

The facts involved are, however, of great practical importance—for instance, adjacent crops of wheat and rye, or of wheat and oats or barley may be grown without fear of infecting one another: nor need the proximity of *Triticum repens* or *Poa* in the hedge banks be dreaded as sources of infection. During the present year I have performed some experiments with *Puccinia graminis* which may be worth recording in so far as they corroborate Eriksson's statements and show that the results obtained by him hold good in this country.

Early in the year my friend Mr. F. Barrington kindly obtained for me a supply of over-wintered *Puccinia graminis* on *Poa trivialis* from Narborough near King's Lynn. The spores were found to germinate freely, and on the 6th May Mr. K. B. Williamson and myself applied them to a small barberry bush in my garden; in due course the pycnidia appeared, and on the 10th of June perfect æcidiospores were developed, on this day these æcidiospores were applied to a series of plants growing in pots, viz: *Poa trivialis*, *Triticum repens*, barley, rye and oats. On the 9th of July the uredo appeared on the Poa but not on any of the other plants. In order that they might have a fair chance of being infected they were planted in a circle round the barberry, which was just a small bush not more than a foot in height. They were thus not only exposed equally to the æcidiospores but also to the uredo spores, which had already formed on the *Poa*. From time to time these plants were examined until they were finally pulled up on the 15th of September; at which time careful examination showed them to be fungus-free with the exception of the Poa, on which teleutospore beds were present. Thus Eriksson's statement is absolutely confirmed as to the species on *Poa*, being biologically distinct from those on oat, barley, *Triticum repens* and rye.

Æcidiospores on Berberis vulgaris from		Plant Infected.	Date.	Date of first result.
1304.	Poa trivialis	Poa trivialis	18 June	9 July.
1305.	„	Triticum repens	18 June	—
1306.	„	Hordeum vulgare	18 June	—
1307.	„	Avena sativa	18 June	—
1308.	„	Secale cereale	18 June	—

Further cultures were also made on 18th June by applying the uredospores on *Triticum repens* to another series of pot plants viz: *Tr. repens*, barley, wheat, rye, oat and *Poa trivialis*. On the 3rd August the *Triticum repens* had well developed uredospore beds but the other plants remained free. On the 15th September these plants were gathered and carefully ex-

amined, soon after infection, these plants like those in the previous series had been planted out in the garden. Each pot contained about six seedlings of each of the cereals.

	Uredo graminis from	Plant Infected.	Date.	Date of first result.
1310.	Triticum repens	Triticum repens	18 July	3 August.
1311.	„	Hordeum vulgare	18 July	—
1312.	„	Secale cereale	18 July	—
1313.	„	Avena sativa	18 July	—
1314.	„	Triticum vulgare	18 July	—
1315.	„	Poa trivialis	18 July	—

It would appear then that our English fungi are even more fastidious in their tastes than the Swedish for Eriksson finds that the form on *Triticum repens* is also capable of affecting both rye and barley. Of course the negative result I obtained cannot be seriously compared with the hundreds of experiments which Eriksson and Henning have conducted.

There is one error into which my continental friends have fallen about myself that I should like to take this opportunity of correcting. They consider that I have succeeded in producing the *Uredo graminis* on wheat from sowing the sporidia (promycelial spores) on wheat: this is a mistake I have never done so. It is true that in my first series of cultures made in 1883 *Uredo graminis* appeared on some wheat plants to which the germinating teleutospores had been applied, but the plants had not been protected from external (atmospheric) infection and even grown in a small garden in which a great number of other wheat plants were growing all of which that year became sooner or later attacked by the disease. In the following year I repeated the experiment taking care to keep the infected plants continously covered by a bell-glass and of course obtained negative results.

One of the tangled problems in the heterœcious Pucciniæ is presented by that group which forms its teleutospores on *Phalaris arundinacea*. Just as the barberry seems to be the common home for the æcidiospores of a whole host of biological species of which *P. graminis* is the type: so *Phalaris arundinacea* is the teleutospore-host for an extensive group of species of the *P. sessilis* type, having their æcidiospores on many plants, viz.: *Allium ursinum*, *Convallaria majalis*, *Arum maculatum* and *Paris quadrifolia*.

Dr. Klebahn has for some years conducted a long series of cultures with the view of determining the stability of these species. In the subjoined tabular summary, which he has obligingly sent me, of the results he has obtained of our state of knowledge of the subject up to date is shown.

Æcidial Host-plant.	Teleutospore.	Dr. Klebahn's Remarks.
Arum maculatum, L.	P. phalaridis Plow. = P. ari-phalaridis, Kleb.	A distinct species, as shown by experimental cultures of Dietel, Klebahn, and Plowright.
Allium ursinum, L.	P. sessilis Schneider = P. winteriana. Magnus = P. allii-phalaridis, K.	
Maianthemum bifolium Schm. Polygonatum multiflorum, All. " verticillatum, All. Convallaria majalis, L. Paris quadrifolia, L.	P. sessilis Schneider in part = P. smilacearum-digraphidis, K.	A distinct species.
Convallaria majalis, L.	P. digraphidis, Sopp = P. convallariæ-digraphidis, K.	From the experiments of Klebahn and Soppitt, this species appears distinct from the preceding, but it possibly may have developed from it, and therefore may be regarded as a sub-species.
Paris quadrifolia, L.	P. paridis, Plow = P. paridis-digraphidis, K.	Distinct, according to Plowright, from P. convallariæ-digraphidis, but as it may possibly have developed from P. smilacearum-digraphidis, it may be considered as a sub-species.
Leucojum æstivum, L.	P. schmidtiana, Dietel.	Most probably a distinct species, but not yet proved so by serial cultures.
Orchis maculata, L. latifolia, L. Platanthera bifolia, Reich. chlorantha, Ceut. Listera ovata, R. Brown.	P. orchidearum-phalaridis, K.	A distinct species, according to Klebahn's cultures, but it has as yet only been found by him growing naturally in company with P. convallariæ-digraphidis and P. smilacearum-digraphidis. Further cultures are desirable.

In order to test the stability of the species Klebahn has since 1892 conducted a series of cultures in which the æcidiospores from one species of host plant have been year by year sown on other host plants known to harbour the parasite. *P. smilacearum-digraphidis* has been the species selected which as will be seen from the table has its æcidiospores on five plants viz.: Maianthemum bifolium, Polygonatum multiflorum, P. verticillatum, Convallaria majalis and Paris quadrifolia. The æcidiospores from Polygonatum only were employed, these were placed on Phalaris and the resulting P. teleutospores next year applied to the above named plants: from the resulting æcidia only those on *Polygonatum* were again used, and so on. In 1895 the æcidia were less abundant and only poorly developed on Paris. In 1897 none were formed on Paris at all, and it has failed to develope the parasite since, at the same time the fungus was not so well developed on Maianthemum, and in the following year Convallaria was not so freely infected; while all through the series the *Polygonatum* plants produced the æcidia most freely and most perfectly. This looks as if there were a tendency for the species to become specialised on one particular host, although the results obtained were not absolute.

Klebahn found that the common æcidium on Orchis latifolia was connected with a Puccinia on Phalaris *(P. orchidearum-phalaridis K.)* Originally Rostrup led us to believe that the orchid æcidium was connected with the Puccinia on Molinia cærulea: but from several experiments I have made at King's Lynn it was apparent that our æcidium on *Orchis latifolia* had some other life history. Accordingly, I determined to repeat Klebahn's cultures upon *Phalaris* with it. A supply of the *Phalaris* having been obtained from Barton Broad from a place near which none of the other host plants except the orchis grew. The teleutospores were this year germinated and applied to a series of plants viz.: *Orchis latifolia, Arum maculatum, Allium ursinum* and *Convallaria majalis* on 10th May. On the 19th yellow spots were observed on the orchid followed in a few days by pycnidia. No effect was observable on the other plants—but after a short time certain pale spots were observed on the *Convallaria* which by the 20th were so evident as to be unmistakeable. (The specimen I now shew you). These spots hardly look like at first sight as if they were due to the growth of the parasitic mycelium of a uredine, for although there is a change of colour in the chlorophyll, yet there is no thickening of the tissues as is the case when these mycelia are present, in fact if the leaf be held up to the light it will be seen that the chlorophyll colour has been discharged: the mesochlorophyll is gone and but little else left except the epidermis of the upper and

lower leaf surfaces. That this result was due to the teleutospores there cannot be much doubt as the infected plant was one of some dozens on none of which were any similar decoloration observable although careful search was made.

The æcidiospores on the orchis were mature early in June and on the 16th were applied to two healthy plants of *Phalaris arundinacea* which on the first July had uredo spore sori developed on them.

1251.	Puccinia orchidearum — phalaridis K.	Orchis mascula ?	31 March		
1276.	„ „	„ latifolia	10 May	19 May	
1277.	„ „	Arum maculatum	10 May		
1278.	„ „	Allium ursinum	10 May		
1279.	„ „	Convallaria majalis	10 May	28 May	
1302.	Æcidium orchidis	Phalaris arundinacea	16 June	1 July	
1303.	„ „	„ „	16 June	1 July	

In 1866, Œrsted, of Copenhagen, showed that the three common *Gymnosporangia* were connected with the three common *Ræstelia*. Subsequent work showed the existence in England of a fourth species *G. confusum*, while on the Continent Hartig has demonstrated the association of a fifth G. *tremelloides* with the *Ræstelia* on the apple. These last two species are found to have these Æcidiospores on several hosts. So far *G. tremelloides* has not been recorded in Britain, but its existence is worth bearing in mind.

After the lapse of eight years, Wolff showed the connection between *Peridermium pini* and *Coleosporium senecionis*. Between the years 1881 and 1888 I repeated Wolff's experiments of putting the spores of *Peridermium pini* on *Senecio* eleven times, once only with success. The problem was attacked by Klebahn, who showed that other *Coleosporia* besides *C. senecionis* had their æcidiospores on *Pinus sylvestris:* his work has been supplemented by E. Fischer. The result of their investigations will be found in the appended list of British Uredineæ.

As early as 1883 Rostrup and Nielsen pointed out the connection between the Cœomata and the Melampsoræ, and I attempted the repetition of their work, but with little success. I did succeed in producing *Cœoma mercurialis* on *M. perennis* from a Melampsora on Poplar, but I was misled as to the species of poplar, being unfortunately told by the late Mr. B. Acton that it was *P. alba*, whereas the leaves in question subsequently proved to be those of a young plant of *P. tremulæ*, he having been misled by their pubescence. Hence I erroneously referred the *Melampsora* to *M. æcidioides*. I am glad of the present opportunity of correcting my error. In 1888 I worked out the life history of the *Cœoma* on *Orchis maculata*, but it was not until the present year that I have

been able to confirm Rostrup's statement that *Cæoma Euonymi is* related to the *Melampsora* on *Salix cinerea*. This I was enabled to do by the kindness of my friend, Mr. E. J. Tatum, of Salisbury, who took me in June last to a locality near that city, where we were able to gather a few specimens of the *Cæoma*. Although the season was rather advanced, yet I applied these to a plant of *Salix cinerea*, which I had growing in my garden, with the satisfactory result of producing the uredospores in question.

Mr. Tatum has further been fortunate enough to find *Cæoma confluens* on *Ribes grossuluria* in the near neighbourhood of a number of Salices. I have therefore hope, at some future time, to confirm Rostrup's and Nielsen's statement that this fungus is connected with one of the *Melampsoræ*. These two cultures would be particularly interesting to me since many years ago I attempted their performance with teleutospores of certain Melampsoræ, collected in Norfolk, but with absolute non-success. We have here, then, one other instance of the complexity of the life histories of the Uredineæ, and again have to decide whether they be species or spore-forms that we are dealing with.

I must briefly allude to the life history of one of our commonest Melampsoræ, namely, that on Birch. As will be seen by the table, *Cæoma laricis* has been found to consist of a host of different species, on poplar, aspen, and various willows. As it occurs with me, I find it, as I have elsewhere shown, related to *M. betulinæ*, and as far as my cultures have hitherto gone, with nothing else, with one exception. Klebahn considers that the microscopic structure of my Larch-birch Cæoma is so distinct from the Larch-poplar and Larch-willow species as to merit placing it in a genus by itself on account of degree to which its peridium cells are developed; in fact, it is an Æcidium rather than a Cæoma. He proposes to call it *Melampsoridium betulinum*.

The exceptional case was a culture I made this year with some teleutospores on the leaves of *Populus alba* Mr. Tatum sent me from near his residence. In this case the germinating teleutospores gave rise to yellow spots, which proved on microscopic examination to be pycnidia on *Larix Europaea;* but, unfortunately, the plant died before the fungus had time to develop. This was the only successful result I obtained from seven cultures of Melampsora on *Populus alba*. In the appended list of the British Melampsoræ it is remarkable how many have their Cæomata on Larch. On the Continent the Cæomata of *Melampsora tremulæ* occur on Larch, *Mercurialis perennis*, *Chelidonium majus*, *Pinus sylvestris*, and *Corydalis sp.*

Melampsora pustulata, or as it is more commonly now called, *Pucciniastrum pustulatum* (Pers.), a species not very uncommon in some parts of the country, has been shown by Klebahn to have its æcidiospores on *Abies pectinata*, a not very abundant tree with us.

It would be very desirable to see if the same life-history holds good with us as with him.

The teleutospores of *Uredo agrimoniæ*, a very widely distributed species occurring not only in Europe but also in Asia, Africa and America, have been found to consist of extra-cellular bodies divided into four compartments by two septa at right angles to one another, one longitudinal the other transverse, and is placed by Dietel in this genus. *(Pucciniastrum.)*

Æcidium leucospermum on the wood anemone Mr. Soppitt shewed to be an *Endophyllum*; its spores germinate as do those of the other *Endophylla* and infect young seedling plants only.

Uredo scolopendri Fckl, for which the late Dr. Buchanan White* made the genus Milesia (after the Rev. Miles Joseph Berkeley), is a very interesting fungus; its Uredo spores which are colourless are contained in a conceptacle placed just beneath the cuticle of the plant. They escape through an apical opening, while the teleutospores are formed in smaller clusters more deeply buried in the tissues of the host-plant. Magnus proposes the genus *Urediniopsis* for it. It is not uncommon in this Country on various ferns, *e.g.*, *Scolopendrium*, *Blechnum* and *Polypodium vulgare*.

Colourless æcidiospores besides those of *Endophyllum leucospermum* occur on the Rumices, but the most remarkable and peculiar are those belonging to *Puccinia vincæ*. The Æcidium itself is not cup-shaped, but consists of a round flat somewhat raised cushion-shaped black mass upon the upper surface of which the colourless Æcidiospores, are produced in chains. At first sight, the structure looks more like a *Coryneum* than an Æcidium.

Phragmidium albidum is a fungus we should look for on the various bramble leaves. It was originally described by Kühn as a *Chrysomyxa*. The *Uredo Mülleri* of Schröter is regarded as connected with it: this is an autumnal species with pycnidia, on circular spots. The teleutospores occurred this year at North Wootton, near King's Lynn, and were met with yesterday in the New Forest.

Uredo Chrysanthemi. In 1897 the Chrysanthemum growers of England were alarmed by the appearance of a Uredo on this plant, which like all newly introduced species, spread with great rapidity. In an article on the disease not only were the teleutospores duly figured, but growers were warned of the danger of allowing wild Compositæ, such as Hawkweed, and Burdock, to grow near their Chrysanthemums.

In order to test the truth of this warning, on the 23rd. October, 1898, germinating spores of the Uredo were applied to *Hieracium aurantiacum*, *Taraxacum officinale* and *Chrysanthemum uliginosum*, but without effect.

* B. White. Scottish Naturalist, 1878.

The spores of this *Uredo chrysanthemi* placed in water germinated in a few hours with great vigour. In the course of 24 hours so energetic was the growth of their germ-tubes that they intertwined with one another so that the mass of spores, floating on the culture drop looked for all the world as if it had become mouldy, but the apparent hyphæ were only germtubes. If the spores, which are globose, be allowed to become dry and are examined microscopically in that state it will be seen that one segment of the sphere is very much stronger than the rest, so that the spores collapse laterally in such a way as to resemble those indigo-balls sold by grocers under the name of "thumb blue" and used for laundry purposes. Each spore looks as if it had been compressed on one side between the finger and thumb.

With regard to the Ustilagineæ the same differentiation of species on biological grounds has been demonstrated, only in these cases corresponding morphological characters usually co-exist. The work of Jensen, Brefeld, Swingle, Kellerman, Magnus, Dietel, Cocconi, Kühn, &c., is recognised by all. The old species Ustilago segetum is now known to comprise

Ustilago tritici (Pers.) on wheat.
„ hordei (Pers.) on barley.
„ nuda (Jens.) on barley.
„ perennans (Rost) on Avena elatior.

which differ not only in spore measurements, &c., but in the manner in which the spores germinate as well as in naked eye characters. For instance, the two barley species, one is firm compact and solid, while the other consists of an evanescent dusty mass. Jensen has further pointed out the existence of two species of Ustilago on the cultivated oat which although they have not yet been recognised as British probably occur with us. They are distinguishable by their naked eye characters inasmuch as one *U. avenæ* Pers. destroys the whole head as *U. nuda* on barley does: while the other U. *lævis* K. and S. does not destroy the outer paleæ. Besides this, the spores of one species are smooth but of the other rough.

Two well marked species of *Tilletia* have long been recognised on wheat, one with areolate, the other with smooth spores. Only the former has been observed in Great Britain but the existence of the other should be borne in mind.

The curious Ustilago which some botanists call *Schræteria delastrina* in the interior of the fruit of *Veronica hederacea*, in which the twin spores form a striking feature, has been added to our flora as has also *Ustilago vaillantii* Tulasne which Mr. Greenwood Pim detected on the inflorescence of *Scilla bifolia* in April 1895. The last addition to this group of fungi is the curious *Urocystis filipendulæ* which Mr. Tatum detected on the foliage of *Spiraea filipendula* last year.

One experiment I have performed this year may interest you.

The generally accepted view as to the means by which the Ustilagineæ infect their host-plant is, that the parasite gains admission into the embryo, soon after the seed has germinated. This is the case with *Tilletia tritici*, *Ustilago avenæ*, *Ustilago nuda*, &c., and is indeed generally true. But it is not the way by which all species of Ustilago infect their hosts. For example I have long held the opinion, founded on certain experiments made some years ago, that *U. violacea* on the anthers of *Lychnis dioica* infected its host by the agency of insects, especially bees, which carried the spores directly from an infected, to a sound flower. During the month of June last, I transplanted a vigorous young plant of *L. dioica* affected with the Ustilago from a wood at East Winch, near King's Lynn, into my garden, and planted it in close proximity to a healthy plant of the same species which had been growing there since spring. The transplanted specimen survived the process of removal and produced a succession of smutted blooms. Towards autumn the healthy plant began to produce a few smutted blossoms, the majority of which were on the side nearest the diseased plant. Some of these blossoms I now exhibit. Some are healthy, some bear the Ustilago in their anthers and one branch has blossoms of both kinds.* This, I take it, conclusively demonstrates the truth of my contention that *U. violacea* does not enter the embryonic plant and grow upwards with it as many of the Ustilagineæ do, but that it is implanted directly into the inflorescence by insect agency.

UREDINEÆ. Tulasne.

UROMYCES Link.

I. EUUROMYCES. Schröter.

Auteuuromyces.

Uromyces fabæ (Pers.)
orobi (Pers.)
phaseoli (Pers.)
limonii (D. C.)
polygoni (Pers.)
trifolii (Alb. and Schw.)
geranii (D. C.)
betæ (Pers.)
valerianæ (Schum.)
chenopodii Duby
Uromyces parnassiæ (D.C.)
salicorniæ (D.C.)

Heteruromyces.

Uromyces dactylidis. Otth.
poæ Rabh.
lineatus (Desm.)
= Æc. glaucis
junci (Desm.)
pisi (Pers.) ?

II. BRACHYUROMYCES. Schröt.

III. HEMIUROMYCES. Schröt.

Uromyces scutellatus (Schrank)
anthyllidis. (Grev.)
rumicis (Schum.)

* During the following Spring, 1900, both plants produced nothing but smutted flowers.

Uromyces sparsus (Kze. and Schm.)
alchemillæ (Pers.)
alliorum. (D.C.)
ficariæ. (Schum.)
scillarum. (Grev.)

IV. Uromycopsis. Schröt.

Uromyces behenis. (D. C.)
scrophulariæ. (D. C.)
ervi. (Wallr)

V. Micruromyces. Schröt.

Uromyces ornithogali. (Wallr)
urticæ. Cooke?

VI. Lepturomyces. Schröt.

PUCCINIA. Pers.

I. Eupuccinia. Schröt.

A. Auteupuccinia. De Bray.

Puccinia galii. (Pers.)
asparagi D. C.
thesii (Desv.)
calthæ Link.
convolvuli. (Pers.)
gentianæ. (Strauss.)
silenes. Schröt.
porri. (Sow.)
prenanthis. (Pers.)
lapsanæ. (Schultz)
variabilis. (Grev.)
pulverulenta. Grev.
violæ. (Schum.)
albescens. (Grev.)
bupleuri. (D. C.)
pimpinellæ. (Strauss.)
apii. (Wallr.)
menthæ. Pers.
aegra. Grove.
primulæ. (D. C.)
soldanellæ. (D.C.)
saniculæ. Grev.
vincæ. (D. C.)

B. Heteropuccinia. Schröt.

Puccinia graminis. Pers.
coronata. Corda
coronifera. Kleb.
phalaridis. Plow.
dispersa. E. & H.
poarum. Nielsen.
arenariicola. Plow.
schœleriana. Plow. and Mag.
sylvatica. Schröt.
dioicæ. Magnus.
paludosa. Plow.
obscura. Schröt.
phragmitis. (Schum.)
trailii. Plow.
magnusiana. Korn.
scirpi D. C.
moliniæ. Tul.
bistortæ. D. C.
perplexans. Plow.
persistens Plow.
extensicola. Plow.
winteriana. Mag.
pringsheimiana. Kleb.
magnusii. Kleb.
agrostidis. Plow.
paridis. Plow.
digraphidis. Sopp.
orchidearum-phalaridis. Kleb.

II. Brachypuccinia. Schröt.

Puccinia suaveolens. (Pers.)
bullata. (Pers.)
hieracii. (Schum.)
centaureæ. Mart.
taraxaci. Plow.

III. Hemipuccinia. Schröt.

Puccinia polygoni. Pers.
tanaceti. (D. C.)
iridis. (D. C.)
oblongata. (Link.)
glumarum (Schum.)

Puccinia baryi. (B. and Br.)
pruni. Pers.
acetosa (Schum.)
argentata. (Schultz.)
anthoxanthi. Fckl.
oxyriæ. Fckl.
hydrocotyles. (Link.)
sonchi. Rob.
lychnidearum. Link

IV. Pucciniopsis. Schröt.

Puccinia liliacearum. Duby.
tragopogi. (Pers.)
smyrnii. Corda.

V. Micropuccinia. Schröt.

Puccinia betonicæ. (Alb. and Schw.)
campanulæ. Carm.
schneideri. Schröt.
ægopodii. (Schum.)
epilobii. D. C.
asarina. Kze.
paliformis. Fckl.
virgaureæ. (D. C.)
andersoni. B and Br.
umbilici. Gueo.
fusca. (Relhan.)
bunii. (D. C.)
thalictri. Chevall.
schroeteri. Pass.
fergussoni. B. and Br.
rhodiolæ. B. and Br.
adoxæ. D. C.
ribis D. C.
saxifragæ. Schlecht.
senecionis. Lib.
glomerata. Grev.

VI. Leptopuccinia. Schröt

Puccinia arenariæ. (Schum.)
chrysosplenii. Grev.
veronicæ. (Schum.)
valantiæ. Pers.
malvacearum. Mont.
circææ. Pers.
veronicarum. D. C.
glechomatis. D. C.
asteris. Duby.
millefolii. Fckl.
cardui. (Plow.)
buxi. D. C.
annularis. (Strauss.)

TRIPHRAGMIUM. Link.

Brachytriphragmium.

Triphragmium ulmariæ. (Schu.)
filipendulæ. (Lasch.)

PHRAGMIDIUM. Link.

Phragmidium fragariastri (D. C.)
sanguisorbæ (D. C.)
potentillæ. (Pers.)
tormentillæ. Fckl.
violaceum. (Schultz.)
rubi. (Pers.)
subcorticatum. (Schrank.)
rosae-alpinæ. (D. C.)
rubi-idææ (Pers.)
albidum. (Kuhn.)

XENODOCHUS. Schlecht.

Xenodochus carbonarius. Schlecht.
curtus. Cooke. ?

ENDOPHYLLUM. Lev.

Endophyllum. euphorbiæ. (D.C.)
sempervivi. (Alb. and Schw.)
leucospermum. (D. C.) Sopp.

GYMNOSPORANGIUM. Hedw.

Gymnosporangium sabinæ. (Dicks.)

Gymnosporangium confusum. Plow.
clavariaeforme (Jacq.)
juniperinum. (Linn.)

MELAMPSORA. Castagne.

I. Melampsora.

Melampsora helioscopiæ. (Pers.)
vernalis Nissl.
lini (Pers.)
farinosa. (Pers.)
larici-caprearum. Kleb = Cæoma laricis.
larici-epitea. Kleb. = Cæoma laricis.
mixta. (Schlecht.)
hartigii Thum. = Cæoma grossulariæ.
vitellinæ. (D. C.)
tremulæ. Tul. = Cæoma laricis.
æcidioides. (D. C.)
rostrupii Wagner. = Cæoma mercurialis.
populina. (Jacq.) = Cæoma laricis Hart.
hypericorum. (D.C.)

II. Pucciniastrum. Otth.

M. pustulatum (Pers.) = Æcidium on Abies pectinata.
agrimoniæ. (D. C.) Dietel.
circææ (Schum.)

III. Thecopsora. Magnus.

Melampsora padi. (Kze. and Schm.)
galii (Link)
vacciniorum. (Link.)
pyrolæ. (Gmelin.)

IV. Melampsorella. Schröt.

Melampsora cerastii. (Pers.)

MELAMPSORIDIUM Kleb.

M. betulinum (Pers.)

COLEOSPORIUM. Lév.

I. Eucoleosporium. Winter.

Coleosporium senecionis. (Pers.) = Æcidium pini
tussilaginis. (Pers.) = Æcidium pini
petasitis. De Bary = Æcidium pini

II. Hemicoleosporium. Winter

sonchi-arvensis (Pers.) = Æcidium pini
campanulæ. (Pers.)
euphrasiæ. (Schum.) = Æcidium pini
melampyri (Rebent.) = Æcidium pini

CHRYSOMYXA. Unger.

Hemichrysomyxa. Winter.

Chrysomyxa pyrolæ. (D. C.)
empetri. (Pers.)

CRONARTIUM. Fries.

C. ribicolum. Dietr. = Æcidium on Pinus Strobus.
flaccidum. Alb. and Schw. = Æcidium on Pinus sylvestris.

UREDO.

Uredo chrysanthemi.
symphyti. D. C.
polypodii. Pers.
mulleri. Schröt.
quercus. Brond.
iridis. (Thum.)
phillyreæ. Cooke.
tropæoli. Desm.
lynchii. (B. and Br.)
plantaginis. B. and Br.

MILESIA. B. White.
Milesia scolopendri (Fckl.) B. White.

CAEOMA.
Caeoma saxifragæ. (Strauss.)
euonymi. (Gmelin.) = Melampsora euonymi-caprearum. Kleb.
mercurialis. Pers. = M. rostrupii Wagner.
alliorum. Link.
orchidis. Alb. and Schw. = M. repentis. Plow.
laricis. (Westd.) = Melampsoridium betulinum (Pers.) Kleb.
ari-italici. D. C.
confluens (Pers.)

ÆCIDIUM.
Æcidium aquilegiæ. Pers. = Puccinia agrostidis. Plow.
grossulariæ. (Gmelin.) = Puccinia pringsheimiana (Kleb.)
periclymeni. Schum. = Puccinia festucæ Plow.
Æcidium prunellæ. Winter.
convallariæ. Schum. = P. digraphidis Sopp.
barbareæ. D. C.
clematidis. D. C.
sonchi. Johnst.
ranunculacearum. D. C.
dracontii. Schw.
strobilinum. (Alb. and Schw.)
incarceratum. B. & Br.
phillyreæ. D. C.
galucis. Dozy. & Molk. = Uromyces lineatus Desm.
poterii. Cooke.
punctatum. Pers.
leucospermum. D. C. = Endophyllum.
bunii. D. C. = P. bistortæ
euphorbiæ. Gmelin.
elatinum. Alb. and Schw.
pseudo-columnare. J. Kuhn. ? Pucciniastrum pustulatum.

USTILAGINEÆ. Schröter.

USTILAGO. Pers.
Ustilago longissima. (Sow.)
hypodytes. (Schlecht.)
tritici. Pers.
hordei. Pers.
nuda. Jens.
perennis Rost.
grandis. Fries.
grammica. B. and Br.
marina. Durieu.
hypogæa. Tul.
caricis. (Pers.)
bistortarum. (D. C.)
olivacea. (D. C.)
Ustilago bromivora. (Tul.)
maydis. (D. C.)
vinosa. (Berk.)
scabiosæ. (Sow.)
flosculorum. (D. C.)
utriculosa. (Nees.)
violacea. (Pers.)
vaillantii Tul.
major. Schröt.
kuhneana. Wolff.
tragopogi. (Pers.)
cardui. E. v. Wald.

SCHROETERIA. Winter.
Schroeteria delastrina. Wint.

SPHACELOTHECA. DeBary.
Sphacelotheca hydropiperis. (Schum.)

TILLETIACEI. Schröt.

TILLETIA. Tulasne.
Tilletia tritici. (Bjerk.)
decipiens. (Pers.)
striæformis. (Westd.)
rauwenhofii F. v. W.

UROCYSTIS. Rab.
Urocystis occulta. (Wallr.)
agropyri. (Preuss.)
fischeri. Korn.
colchici. (Schlecht.)
sorosporioides. Korn.
gladioli. (Requien.)
anemones. (Pers.)
violæ. (Sow.)
primulicola. Magnus..
filipendulæ. Fckl.

ENTYLOMA. De. Bary.
Entyloma fergussoni. (B. & Br.)
bicolor. Zopf.
ranunculi. (Bon.)
matricariæ. Trail.
chrysosplenii. (B.&Br.)
microsporum. (Ung.)
calendulæ. (Oud.)

MELANOTAENIUM. De. Bary.
Melanotaenium endogenum. De. Bary.

TUBERCINIA Fries.
Tubercinia trientalis. B. and Br.
scabies. Berk. ?

DOASSANSIA Cornu.
Doassansia alismatis. (Nees.)
sagittariæ. (Fckl.)

THECAPHOREI. Schröt.

THECAPHORA Fingerhuth.
Thecaphora hyalina. Fing.
tralii. Cooke.

SOROSPORIUM. Rudolphi.
Sorosporium saponariæ. Rud.

GRAPHIOLA. Poiteau.
Graphiola phœnicis. (Moug.)

ENTORRHIZA. C. Weber.
Entorrhiza cypericola. Magnus.

TUBERCULINA. Sacc.
Tuberculina persicina. Ditm.

PROTOMYCES. Unger.
Protomyces macrosporus. Unger.
rhizobius. Trail.
pachydermus. Thum
menyanthis De Bary
ari Cooke.

MOLLISIA CINEREA AND ITS VARIETIES.

By Charles Crossland, F.L.S.

While examining Molliseæ of the cinerea group one has often put to oneself the query—What is the real *Mollisia cinerea* = *Peziza cinerea* first described by Batsch Contr. myc. I. p. 196. fig. 137.?

This question has been a puzzle to successive generations of Mycologists and most likely will remain so.

It appears to be difficult to say what the real species was which Batsch had before him, from which he took the following description:

> "Sessile, cinereous, reflexed, margin crisped and sinuate-
> "lobate.
>
> "Orbicular when young, or oblong and more closed;
> "when full grown more spreading, irregular, when more
> "fully grown irregularly pulvinate, disc obsolete, scrobiculate
> "margin lobate, lobes short and rather broad; margin be-
> "tween the elevated lobes depresso-sinuate, and therefore
> "crisped.
>
> "Substance horny; semipellucid, cinereous, somewhat
> "moist, dark, but becoming white when it begins to dry,
> "when dry membranaceous, dirty white.
>
> "The substance, scrobiculate and crisped margin, differs
> "it from *grisea* Elenchi, but possibly it may be a variety
> "of it."

At first sight this appears to be fairly comprehensive for a superficial description of a species so small as a Mollisia.

Unfortunately for it, some species of Mollisiæ exhibit varying phases according to age and conditions of growth: sometimes the hymenium will be plane, with even margin, and the ascophores small ($\frac{1}{2}$ mm.); at other times the development of the hymenium will be so luxuriant as to force itself into all kinds of contortions, with margin fantastically waved or lobed, and the ascophore large (3 mm.) The colour also may vary a little. When growth is most luxuriant the disc is whitest. Further, the ascophores may be scattered and quite free from each other, or densely crowded and much contorted through mutual pressure.

Thus we have data furnished for very variable external descriptions. Microscopic characters are the most constant and reliable, but, at the time Batsch described his species, 1784, external descriptions were mostly relied upon, those of a microscopic nature not being sought into. Batsch does not mention the spores, nor even the asci, in any way.

The species most generally accepted as *M. cinerea* is the one that is very common on dead wood and branches, almost anywhere; it has an undulate, pale cinereous disc, crisped margin, guttulate, narrowly elliptical-oblong spores 6-9 μ long by 2-3 μ thick, glistening paraphyses 3 μ thick, and brown, septate hyphae springing from beneath the ascophore.

Several distinct species of Mollisia, Belonidium, etc., are very similar in external appearance to this one, and would fit Batsch's description quite as well. Some of these have no doubt been passed over by pocketlens examination for the common species accepted as M. cinerea. For instance a comparatively new species, *Echinella setulosa* Mass, and Crossl. found on Calluna vulgaris often bears a striking external resemblance to some forms of the common species, and had several times been passed over before being microscopically examined. The margin was found to be minutely setulose (not readily recognised) and the spores to be 4-5 times the length of those of the common species viz: 38-45 by 2·5-3μ. We found another very similar thing on bark (not yet determined) with the spores 9-14 by 3-4μ, finally 3 septate.

While distinct species have been taken for cinerea, the common form has on the other hand undoubtedly been described under several names on account of its variable appearances.

Saccardo Syl. VIII. n 1393, includes, as synonyms, under Mollisia cinerea (Batsch) Karst. M. F. 1 pag. 189, P. cinerea Batsch. cont. 1,p. 196, f. 137, Sowerb. f. 64, Nees syst. f. 269 P. Callosa Bull. Champ. pag. 252 t. 416, f. 1, Batsch. cont. 1 I. p. 95. f. 219 (icon non obstat) Flor. Dan. f. 1490, f. 2, P. plana, P. alnea et obconica Schum. I. c. pag. 417, 423, P. sub-carneo-pallens A.S. p. 307, P. salicaria Pers. Nipt. cin. Fuck. Sacc. F. it. f. 1376.

The above may or may not be true synonyms, I cannot say, some authors do not think they are.

Saccardo, however, in addition to the above brings under the shade of cinerea no less than 12 other varieties and forms whose spore characters are scarcely consistent with the idea that they can be brought under one species.

The 12 forms or varieties Saccardo includes under M. cinerea. Syl. VIII. n 1393. with dimensions of Asci, and spores, and characters.

	Asci.	Spores.	Habitat.
a luteola -	25-35 × 4-5μ	5-6 × 1-1·5μ	*On decorticated castanea.
b grisella -	40-45 × 4μ	9-10 × 1·5-2μ	*Eupatorium cannabinum.
c culmina -	35-45 × 3·5-4μ	5-6 × 1-1¼μ	*Grass culms.
d caracina Sacc.	55-60 × 5μ	10-12 × 1·5-2μ	*Carex glauca.
e olivescens Sacc.	60 × 5μ	8-10 × 2-2·5μ	Decayed wood.
f macrosperma -	60 × 10-12μ	12-14 × 2-3μ	*Rotten wood.
g albo-nigella -	40-50 × 7μ	9-11 × 1·7-2μ	Atriplex.
h minutella -	36-40 × 5-6μ	7-8 × 1·5-2μ	Spiraea.
i leptospora -	40-50 × 5-6μ	13-14 × 2μ	Epilobium.
j epilobii Kunz -	40-45 × 5μ	6-7 × 2·5μ	Epilobium.
l canella Karst -	50-67 × 6-7μ	8-14 × 2-3·5μ	Alnus and Quercus.
m revineta Karst	40-45 × 4μ	6-8 × 1-1·5μ	Spiraea.

The star'd spores are stated to be 2-guttulate.

The spore dimensions varying from 5-6 by 1-1¼ μ in *culmina* to 8-14 × 2-3·5μ in *canella* Karst. The dimensions of the asci are also extremely variable, ranging from 25-35 by 4-5 μ in *luteola*, to 60 by 10-12 μ in *macrosperma*. We cannot conceive of variation to this extent coming under one species, either as forms or varieties.

Without any desire to increase the number of species by any hair-splitting policy, it may be that several of the 12 forms deserve specific rank. Dr. Rehm in Rabhn. Krypt Flora Albthung III. p. 525, has given this to *minutella*, and placed *epilobii* Kunze under it as a synonym.

We do not think species with 2 guttulate spores should be placed here. If spore characters have to count for anything *leptospora*, 13-14 by 2 μ, and eguttulate, cannot possibly be classed with *culmina* spores 5-6 by 1-1¼μ and 2 guttulate. So with others. Five of the twelve are stated to have 2 guttulate spores. Independent of variability in size, we do not consider any form having guttæ in its spores should come under the common *cinerea*.

In well known species, (not particularly Mollisiæ), that have guttulate spores, the guttæ are constant, and vice-versa so that it is not safe to unite under one species, those having *guttulate*, with those that have eguttulate spores. Characters that can be proved to be constant, and are distinct from those pertaining to other species, must count for something in the summing up, of what we understand as specific differences. Batsch's species was found on wood and Saccardo placed it in his Ligni corticola section all right yet four only of the 12 sub-pended forms, *luteola*, *olivescens*, *macrosperma* and *canella*, are stated to grow on wood, while the remaining 8 are on herbaceous stems.

If species inhabiting herbaceous stems may be included why not *atrata*, *atro-cinerea*, *Lycopodei* spores 8-9 by 1·5-2·5 μ *polygoni* sp. 7-9 by 2 μ *lycopincola*, spr. 7-10 by 2-2·5 μ *coeruleus* spr. 10 μ long etc., etc.

If this method is adopted all these and others might be brought under the convenient wing of the common *cinerea*.

Seeing that this common species is practically spread over the globe we must allow it scope for variation, but we must at the same time, have a limit. If we could place under *cinerea* all *Mollisiæ*, with a cinereous, whitish, or pallid, concave, plane, undulate, or contorted hymenium, margin even or crisped; spores oblong or oblong-fusiform, hyaline, continuous, and eguttulate, with a limit of dimensions to 6-10 μ long by 2-3 μ thick; and paraphyses rather stout and rigid 3 μ thick with shining oily looking contents and no other kind, we should arrive at something definite. Some authors state that the base is furnished with brown hyphæ. These are often seen in the common species, but this factor, in itself is not a distinctive character, as brown hyphæ also occur in other species. Belonidium pullum, for instance.

A thorough revision of the genus is out of the question. An examination of the various exsiccati, even if one had the opportunity, and the perseverance necessary to perform the task, seems hardly likely to produce a satisfactory result. It is impossible to sufficiently revive the dried specimens so as to accurately determine the essential characters.

At the same time it is very desirable to have a more exact classification of this genus: and a more definite limit fixed to the various species; care being taken on the one hand not to confound species which are different, and on the other, not to multiply species by failure to observe the differences of the same species which may be due only to variations of light, moisture, situation, age, etc. This can only be done by careful records of fresh material with thoroughly accurate descriptions and drawings, with special regard to the difficulties which have now become so painfully apparent.

NOTES ON HANTS FUNGI.

By Rev. W. L. W. Eyre, M.A.

The circular of our present Meeting announces a paper, "Notes on Hants Fungi." The remarks I have to make are limited to the larger forms. There are apparently few persons who take much interest in our Fungi—as one of those few, a long residence in the County, and opportunities through moving about my parish to collect and identify the various forms, are the reasons which I would offer as a sort of justification for venturing to address members whose knowledge of the matter is far more wide and intensive. Some of us in connection with the Hampshire Field Club have made attempts to bring the subject of the Fungi into greater notice. We cannot at present be said to have met with much success. Natural history does not seem to be as popular as the antiquities and local history of our towns and villages. A few years ago we organized a day meeting—assembling at the close in the Hartley Institute, Southampton; on two or three occasions since we have met at Lyndhurst. The results of our wanderings were the identification, chiefly by Dr. Cooke or Mr. Massee, of the species found. It is these species gathered on these occasions that I have admitted into the printed list—copies of which I would ask your acceptance lie on the table before me. The list is based primarily on knowledge of the Fungi growing in the northern part of the County. So far as it extends, the list may be relied upon with every confidence, most generous assistance has been rendered by our leading authorities, and nothing questionable has been admitted without a large amount of certainty.

It is important to mention this because the appearances of the Fungi are so erratic; some I have only seen once or twice, and it might be thought, if not found, some error had crept in. Among these varieties are *Cortinarius azureus* and *russus*, *Lepiota Badhami*, *Russula aurata* and *citrina*, but sketches made at the time leave no doubt but that these species have really occurred.

Some species the County has produced for the first time in the British Islands, as *Cortinarius azureus*, *argutus*, *firmus*, *riculatus*, *injucundus*, *subnotatus* and *triformis*, it is quite possible that we may meet with these again in our present researches, but so far, they belong

rather to the upper part of the County than the south. *Clitocybe zygophylla* may be added, with *Schulzeria Eyrei*, the latter very unusual, so few of this genus being as yet known throughout the world—the spores are bluish-green—a figure may be found in the last number issued of "Grevillea;" both of these only occur in the neighbourhood of the Grange Park.

Cortinarius orichalceus is a peculiarity of the New Forest, Dr. Cooke pointed it out on the green near Emery Down, in front of the Swan Inn. *Lactarius cyathula*, under birches, on rising ground east of the Kennels, near Minstead, is another, the only places where these are known to grow. *Boletus duriusculus* is a third, though found sparingly in other places, but in Hampshire only in the Forest.

The partiality of certain Fungi for places such as rotten wood is well known; but I would like to suggest the desirability of the quality of the soil (where possible) have a more prominent place in our descriptive notes. Flowering plants are located pretty definitely owing to the invention of the Watsonian provinces and their sub-divisions, but this is geographical. A geological enumeration would add still further information to the objects of our special study. Not much has yet been done in either direction; something of this kind might be of advantage in the future. May I illustrate my meaning, from what I have observed of certain species in my own district compared with the Forest; in the north of the County there is a large portion consisting of bare chalk, another of clay or chalk marl, and some Fungi year after year cling to the one district, irrespective of what goes on in the adjoining part. Particular species seem to keep very close to their own selections.

On the chalk we find *Amanita strobiliformis*, *Entoloma Bloxami*, *Stropharia inuncta*, *Cortinarius dolabratus* and *rigens*, also *Clitocybe nebularis*. *Amanita strobiliformis*, thought very generally to be among the rarer kinds, is with us in the months of August and early in September extremely abundant, so much so that scores may be seen destroyed by the labourer's boot as he returns over the downs at the close of his day's work; indeed, we value this species next to the mushroom as one of the best for culinary purposes, cooked slowly in milk after being cut into pieces it makes no bad imitation of scolloped oysters. On one particular bank we can generally secure *Boletus satanas;* these half-dozen or so we may class as definitely preferring the chalk —*Tricholoma spermaticum*, *Russula vesca*, *Lactarius scrobiculatus* and *controversus*, *Psilocybe semilanceata*, *Clitocybe zygophylla* with *Cantharellus cibarius*—have a distinctive love for the clay or chalk marl. Our clay is not of the tenacious, glue like quality of some districts, but it seems to sufficiently influence the growth of the above species.

As to the New Forest, with more sand in the composition of the soil, we have *Tricholoma sejunctum*, *Lactarius cyathula*, *Clitocybe clavipes*, *Cortinarius orichalceus* and *sanguineus*, *Boletus duriusculus*. None of

these, and there are others, do not occur in the north of Hants, so that the mention of soil as well as form, with other details, should enter into our definitions.

Such a proposal does not seem a difficult one to carry out. County lists where they exist might be examined and the matter tested. If these lists are at present too imperfect, someone, from what is already known, might take the subject and follow it up. Our Annual Meeting would form a good occasion for comparison.

Fungus forays are apt to assemble and disperse, and facts known perhaps to a few escape permanent record. The point I would emphasize is, do Fungi, the larger forms more especially, conform to geological conditions? The amount of moisture and temperature doubtless have a predominant influence in the growth of these plants, but may not the chemistry of the soil have an importance of which at present we know so little in the prevalence of Fungi in certain areas: light soils 1 foot below surface are 1° warmer than air, heavy soils 1 foot below surface 0°2 warmer than annual mean temperature of the air.*

To those who are on the watch, the occurrence of particular Fungi year after year in the same places has been remarked over and over again. They do not appear with the same regularity as the arrival of the flowering plants, they are more casual and uncertain; but the species sooner or later, usually, if not this season then the next, come up in the old places. Being so perishable, passing away many of them in so short a time, makes the matter one demanding pretty close attention. Still, it does seem not at all an *impossible* aim to attempt; probably an additional stone might be added to the accumulating heap of knowledge that has been slowly and patiently gathered during the last few years of the century, of a curious and interesting study.

Our list of Hants' Fungi, as here printed, reaches 580 species, about 30 found in the Forest have not yet been found *except in the South*. The district most closely examined is the Grange Park as a centre, lying between Alresford and Micheldever.

* See J. of Royal Meteorological Society, Vol. xxv. p. 252.

FUNGI NEW TO BRITAIN.

By Annie Lorrain Smith.

Apodachlya Pringsh.

Hyphae with cellulin grains, constricted at intervals, branched, the branches rising immediately below the constriction; sporangia terminal, pyriform or globose, few-spored; zoospores on escaping become surrounded by a thin pellicle and remain for a time at the mouth of the sporangium, swarming later with two lateral cilia and leaving a hollow sphere of empty cells; sexual organs unknown; conidia terminal, globose.

A. pyrifera Zopf.

Mycelium long; sporangia pyriform, sometimes ovate or fusiform with a small beak, a fertile branch often rising beneath the emptied sporangium, the repeated branching forming a sympodium; spores bean-shaped; conidia globose, with a smooth cuticularized outer wall. Found by Dr. Maurice Gepp on a hazel stick floating in running water near Shrewsbury. Journal of Botany. May 1899. Communicated by Mr. A. Gepp.

Achlya racemosa Hildeb.

Hyphæ large up to 80 μ thick; sporangia cylindrical-clavate, large, varying in size from 166-640 μ in length by 64-21 μ in width; oogonia terminal on short stout branches, produced in great numbers along the main hyphae, globose, 50-57 μ in diameter with a thick brownish or yellowish membrane with few oospheres; antheridia always present one or two to each oogonium, obconical, on slender branches which rise from the stalk of the oogonium; oospores few 1-6, rarely up to 12, globose, thick walled, smooth, 20-30 μ in diameter.

Var. *stelligera* Cornu, similar to the above but the oogonium beset with wart-like outgrowths.

Found on a hazel stick floating in running water near Shrewsbury. Journal of Botany. May 1899.

Dictyostelium Bref.

Forming mucor-like heads of spores on a long stalk, white or reddish; stalk simple or sparingly branched,cellular; spores

producing on germination an amoeboid body, these bodies flow together and gradually creeping upwards they build up the stalk and the head of naked spores.

The genus Dictyostelium forms part of a small group of organisms the *Acrasieæ*. They were included among the *Mycetozoa* by De Bary but have been separated off from those by recent writers, on the ground that they do not form a true plasmodium.

D. mucoroides Bref.

Whole plant greyish white ; stalk gradually tapering upwards ; head of spores round, varying very much in size, dispersing when touched ; spores elliptical, variable in size, usually about 5 by $2\frac{1}{2}$ μ, colourless.

My attention was first called to this plant by Mr. F. Jenkin who found it growing on an old cardboard box at Newport some years ago. I have again found it growing on some rabbit dung that I gathered at Llanwymawddwy, N. Wales, in Aug. 1899. The material was put away in a perfectly dry condition for some months, then when moistened and kept damp, this and other fungi grew abundantly. I cannot find any record of *Dictyostelium* for this country. Mr. Jenkin first detected it in January 1897. It can only be seen under the microscope and in a growing condition.

Didymocladium Sacc. Syll. Fung. IV. p. 186.

Fertile hyphæ erect, veticillately branched ; conidia borne at the tips of the branches, elliptical, 1-septate, catenulate, colourless.

D. ternatum Sacc. *Cladotrichum ternatum* Bon. Handb. p. 78 fig. 86. Forming white woolly tufts, branches short usually in verticils of three, tapering to the tips which are inflated more or less with conidia in formation ; conidia elliptical in rather long chains with a tendency to drop apart. The size of spores is not given ; in the specimen under examination they measure 12-15 μ by 5μ, as the other characters agree with the above description I have no hesitation in assigning it here. Found by Rev. W. L. W. Eyre on old *Stereum* at Alresford, Hants. Dec. 1899.

Trichosporium splenicum Sacc. and Berl. Miscell. Myc. II. No. 137. t. IX. f. 14 (In Venezia Istit. Atti. ser. 6 Vol. III. pt. 1. p. 141. 1885).

Effused, velvety, blackish-brown ; hyphæ erect, continuous, olive-brown, branched, 120 by 3 μ, the branchlets asperulate at the tips ; spores obovate-reniform 4-5 by 2-3 μ often 1-guttulate. olive-brown.

Forming velvety patches on bark of decaying wood. Llanwymawddwy, N. Wales. Coll. Aug. 1899.

Coniothyrium Kerriae Le Bret. in Rev. Myc. Oct. 1891. p. 169.

Pustules scattered, numerous, pulvinate, developed under the bark about $\frac{1}{2}$ mm. in diameter; spores globose brown 4-6 by 4-5 μ

On dead branches of *Kerria Japonica*, Seamill, West Kilbride, Ayrshire. Nov. 1897. Mr. D. A. Boyd.

Protomyces Bellidis Krieger.

Forming small yellow spots on the leaves, scattered or crowded, with little or no swelling of the tissue; resting spores faintly yellow, globose or somewhat longer than broad 30-45 μ in diameter, smooth, the epispore 1.5-3 μ broad.

Growing on leaves of Bellis perennis at Seamill, West Kilbride, Ayrshire. Autumn 1899, and also in previous years. Mr. D. A. Boyd.

Thelebolus Tode. Fung. Meckl. Sec. I. p. 41.

Forming a closed fruit consisting of an outer layer (stroma) which contains usually one ascus surrounded by an inner investing layer (perithecium), or several asci each with its own investment enclosed in the outer common layer; asci many-spored; spores elliptical, one celled, colourless, gathering into a ball at the apex of the ascus before expulsion; paraphyses very delicate, evanescent.

T. nanus Heim Æsterr Ascob. p. 30 f. ii.

Very minute, globose or somewhat flattened up to 130 μ in width, colourless; asci one or more, somewhat elliptical, varying in size and form swelling after escape from the perithecium, from 50-100 by 30-55 μ up to 140 by 80 μ; spores 5-6 by 3 μ; paraphyses slender, septate.

The inner investing layer of the ascus is very delicate and easily overlooked, so that when several are present the plant presents the appearance of a single perithecium containing several asci. On rabbit dung, Llanwymawddwy, N. Wales.

The same plant has been collected for two years in succession by Dr. Plowright on rabbit and cow's dung at King's Lynn. Zukals microscopic measurements for *Thelebolus stercoreus* (Denkschriften der K. K. Akademie der Wissenschaften, Band 51, 2nd Abtheilung p. 22) have been adopted by succeeding writers, Saccardo, Schroter and Rehm, though Schröter (Kryptogamen-Flora von Schlesien, Band III., 2 Hälfte, Lief I. p. 51.) queries the identity of the two plants, Zukals being about 1-10th of a mm in diameter, while Tode's is described and figured as the size of a "poppy seed." The plant I have been dealing with is smaller than Schröters; I have followed Heimerl's nomenclature, placing it under *T. nanus* though I am strongly inclined to think it is only a smaller form of Zukal's plant, the only difference

between the two species is the size of the mature plant and of the asci, the spores in both species are almost alike. I have never been able to see the paraphyses.

Barlaea modesta Sacc. Karsten, Mon. Pez. Fenn, p. 122.
Among Hepatics on sandy soil, bank of stream, Wade wood, Luddenden Dean, near Halifax. T. W. Woodhead, Oct 1898. Naturalist Jan. 1899. p. 27.

Humaria rubens Boud. Bull. Soc. Myc. 1896. p. 13.
Among moss on wall top, Nut Clough, Hebden Bridge, Oct. 1899. Collected by Mr. James Needham. Naturalist Jan. 1899. p. 27.

H. deerata Sacc. Karst. Mon. p. 119.
On decaying flax-lining of a cast-out hearthrug, Pecket Wood, near Hebden Bridge. June 1897. J. Needham. Naturalist, Jan. 1899. p. 28.

Mollisia pteridina Karst. Myc. Fenn. I. p. 194.
On decaying fern stems, High Greenwood, Heptonstall, May 1897, Naturalist Jan. 1899, p. 28.

Ascobolus Leveillei Boud, Mem sur les Ascoboles p. 35.
In immense numbers on horse dung, Copley, near Halifax Nov. 1898. Naturalist Jan 1899. p. 29.

A. Crosslandi Boud. Bull Soc. Myc. tome XIV. pp. 126-127.
Salterhebble, near Halifax. Oct. and Nov. 1897. Naturalist Jan. 1899, p. 29.

Saccobolus granulospermus Sopp. and Crossl.
On ox dung, Harewood, near Leeds. Sept 1898. Yorkshire Naturalists' Union Fungus Foray. Naturalist Jan. 1899. p. 30.

Lactarius theiogalus. *Fr.*

LACTARIUS THEIOGALUS Fr.

One of the common Lactarii which is frequently overlooked in this county is *L. theiogalus* Fr., a firwood species, of a reddish brown colour; it is passed over for *L. subdulcis*, *serifluus* or *quietus*, a trio which those who have studied fungi the longest are the most chary about discriminating. In the sulphur coloured milk, however, we have a character that at once sufficiently separates the plant under discussion, provided time be given to allow the change of colour to take place. Growing gregariously in late autumn, often amongst short heather, the colour of the pileus, when once recognised, is distinctive. It has, when moist, a peculiar liver coloured tint with a decided brownish shade. The gills are rather distant and the margin of the pileus indented or scolloped where each gill ends; this is best seen from beneath. There is no figure in Cooke's Illustrations: and of those quoted by Fries none are distinctive. Bolton t. 9 is far too bright red. Bulliard t. 567, f. 2, is better, and certainly has yellow milk, but the infundibuliform pileus is distinctly zoned, and a change of colour to yellow is shown in the flesh of section which does not correspond with nature. Krombholz t. i., f. 23 and 24, does not look like the plant at all, while Paulet t. 71 may be anything. Larber t. 17, f. 1, is probably the plant, but Fries does not quote this figure.

Lactarius chrysorheus is not a firwood species, and is known at once by its whitish colour and by the milk changing immediately to golden yellow; whereas in *L. theiogalus* the white milk does not become yellow until after the lapse of a considerable interval, perhaps twenty minutes or half an hour, and even then the colour is never so deep a yellow.

The figures are from drawings by Mrs. Carleton Rea, from specimens found at Ashwicken, Norfolk, 1st November, 1899.

Pileus 2½-7 cm. across, liver coloured when moist, drying to rufous tawny and lighter at the margin, convex when young, then expanded and finally depressed, umbonate, but umbo sometimes wanting, smooth, zoneless, viscous at first; margin crenulate and thin; flesh of the pileus palid, then ochraceous, thick at the centre but thinning out towards the margin. Stem 3-4 cm. long, ½-1 cm. thick, stuffed, then hollow, equal, attenuated at the base, smooth, slightly pinker than the colour of the pileus, flesh becoming rufous especially downwards. Gills adnato-decurrent, each terminating at the crenulations of the margin of the pileus, 3-6 mm. broad, thin, rather distant, pale then rufescent. Milk white, then very slowly changing to sulphur yellow, mild, then slightly acrid. Spores 6-7 μ, globose echinulate.

The following Members have joined the British Mycological Society.

Acland, Sir Charles Thomas Dyke, Holnicote, Taunton, Somerset.

Biffen, Mr. R. H., Botanical Laboratory, Cambridge.

Blackman, Mr. V. H., British Museum (Natural History), Cromwell Road, London. S.W.

Crawford, Mr. W. C., 1, Lockharton Gardens, Edinburgh.

Jenkin, Mr. Charles Frewen, 4, Vanbrugh Park Road, West Blackheath.

Mott, Mr. Frederick Thompson, Crescent House, Leicester.

Paul, Rev. David, LL.D., 53, Fountainhall Street, Edinburgh.

Smith, Mr. Worthington G., 121, High Street, Dunstable.

Tatum, Mr. E. J., Salisbury.

Watson, Dr., Deputy Surgeon-General, University Club, Edinburgh.

OFFICERS FOR THE SEASON 1898-1899.

President: Charles B. Plowright, M.D., King's Lynn.

Hon. Secretary and Treasurer: Carleton Rea, B.C.L., M.A., 34, Foregate Street, Worcester.

THE ROTHIEMURCHUS FOREST FORAY.

17th to 22nd Sept., 1900.

The fourth annual week's Fungus Foray of the British Mycological Society was held at the Boat of Garten from the 17th to the 22nd of September, 1900, and by a happy coincidence the Cryptogamic Society of Scotland had also arranged their annual Foray there. The members of the two Societies assembled at the Hotel Boat of Garten on Monday, the 17th of September, where they found many interesting specimens collected by Dr. C. B. Plowright awaiting their inspection, displayed on tables in the Public Hall, which adjoined the hotel. The Hon. Sec. also put out on exhibition a specimen of *Strobilomyces strobilaceus* Berk., gathered that day by him in the policies of Murthly Castle, and which he understood was of uncommon occurrence in Scotland.

On Tuesday, the 18th of September, the early train was taken to Aviemore; from whence the members proceeded, under the leadership of the Rev. Dr. Keith (President of the Cryptogamic Society of Scotland), to the Dell of Rothiemurchus Forest. Here many interesting species were noted, including *Armillaria robusta* A. & S., *Tricholoma equestre* Linn., *T. portentosum* Fr., *T. pessundatum* Fr., *T. virgatum* Fr., *Cortinarius (Inoloma) traganus* Fr. and *tophaceus* Fr., *Cortinarius (Dermocybe) orellanus* Fr., *Paxillus atrotomentosus* Fr., *Hygrophorus agathosmus* Fr., *Lactarius scrobiculatus* Fr., *Hydnum imbricatum* Linn., *H. fragile* Fr., *H. scrobiculatum* Fr., and *H. compactum* Pers. The walk was then continued to the Rev. McDougal's house, the members gathering on the way specimens of the destructive parasite *Trametes pini* Fr.

On Wednesday, the 19th of September, the Rev. Dr. Keith conducted the members into the adjacent Forest of Abernethy and round to Loch Garten, which is beautifully wooded and stands out in pleasing contrast to the neighbouring mountains. Many examples of *Sistotrema confluens* Pers. were found, and a large patch of *Cordyceps ophioglossoides* Fr. parasitic on *Elaphomyces variegatus* Vitt. was discovered by Professor Marshall Ward, whilst Dr. Plowright secured *Entoloma erophilum* Fr. (new to the British Fungus Flora), *Stropharia scobinacea* Fr., *Flammula scamba* Fr., *Hydnum ferrugineum* Fr., *Stereum Sowerbeii* B. & Br., between the bark of a pine stump, and *Humaria*

violacea Sacc. was found on burnt heaps by the Rev. Dr. Stevenson. In the evening Professor H. Marshall Ward, Dr. Sc., F.R.S., &c., delivered his Presidential Address, entitled "The Nutrition of Fungi" (see page 124), which was much appreciated by the Members of the two Societies.

On Thursday, the 20th of September, the Forest of Rothiemurchus was again visited, our esteemed conductor, the Rev. Dr. Keith, leading the way to Columbridge and thence to Loch-an-Eilan. Many interesting species were gathered on the way, including *Entoloma Bloxami* Berk., *Pholiota flammans* Fr., *Hygrophorus turundus* Fr., *Cortinarius (Inoloma) pholideus* Fr., *Lactarius hysginus* Fr., *Pleurotus mitis* Pers., *Naematelia encephala* Fr., and *Cudonia circinans* Fr. At 6.15 p.m. the business meeting of the British Mycological Society was held. Professor H. Marshall Ward, Dr. Sc., F.R.S., F.L.S., &c., was unanimously re-elected President for the ensuing year, and Mr. Carleton Rea, B.C.L., M.A., Hon. Sec. and Treasurer. Mrs. Montague's invitation to search 4,000 acres of woods near Crediton, with Exeter as head-quarters, was unanimously accepted, and the date fixed for the last week in September, 1901.* Professor Marshall Ward kindly contributed to the Society a valuable paper of original research on "Naematelia" (see page 143). A hearty vote of thanks was accorded to Mrs. Carleton Rea for kindly colouring the 200 plates in the last number. The Hon. Treasurer pointed out that the costs of the Transactions were rather beyond their means, and if the same were to be maintained in a high rate of efficiency more funds were necessary. He suggested that the number of foundation members should be closed at 71 and not limited to 100 as per rules. On the proposition of Dr. C. B. Plowright, seconded by the Rev. Dr. D. Paul, it was unanimously decided that an appeal should be made to the members to contribute voluntarily an annual sum in addition to their subscription until the funds of the Society were sufficient to enable them to publish their Transactions with plates, which were necessarily costly, out of the annual income, and the Hon. Sec. was directed to send a circular embodying this resolution to all the members. In the evening Mrs. Carleton Rea exhibited drawings of Collybia veluticeps Rea and Mycena carneosanguinea Rea, which are shortly described in full at page 157.

On Friday, the 21st September, the members proceeded to the woods to the west of the Boat of Garten, but beyond a *Boletus* thought to belong to the *Gyrodon* group little of any consequence was found, and hence the members in the afternoon again resorted to Abernethy Forest, where fine examples of *Lactarius hysginus* Fr., *Tubaria paludosa* Fr., and *Omphalia umbratilis* Fr. were found.

Saturday, the 22nd September. Many of the members dispersed on this day, but a few ardent members remained to take the 12.15 train to Aviemore, from whence through birch-clad hills they walked to Lynwilg and on to a pine wood some mile to the southward and

* Monday, 23rd September—Saturday, 28th September.

on the right of the road to Kingussie. This wood was found to be the veritable home of the larger Hydnei, and the bag soon included *Hydnum imbricatum* Linn. in great quantities, *H. fragile* Fr., *H. compactum* Pers., *H. aurantiacum* A. & S., *H. zonatum* Batsch., *H. nigrum* Fr., and *H. melaleucum* Fr. Over 231 species were observed during the week's foray, and many of them were of rare occurrence to the southern members.

Dr. C. B. Plowright remained on a visit to the Forest of Rothiemurchus, and has since reported *Flammula carbonaria* Fr., *Amanita porphyria* A. & S., *Cortinarius (Inoloma) alboviolaceus* Fr., *Cortinarius (Inoloma) cyanites* Fr., *Cortinarius (Inoloma) violaceus*, and *Rhizina inflata* Quélet.

List of Fungi gathered during the Foray.

Amanita phalloides Fr., mappa Fr., porphyria Fr., muscaria Fr., rubescens Fr., spissa Fr.

Amanitopsis vaginata Roze.

Lepiota cinnabarina A. & S., carcharias Pers., amianthina Scop.

Armillaria focalis Fr., near Loch Garten, 23rd September, 1900, robusta A. & S., mellea Vahl.

Tricholoma equestre Linn., portentosum Fr., resplendens Fr., flavobrunneum Fr., albobrunneum Pers., pessundatum Fr., rutilans Schaeff., columbetta Fr., vaccinum Fr., imbricatum Fr., terreum Schaeff., saponaceum Fr., virgatum Fr., sulphureum Fr., melaleucum Pers.

Clitocybe nebularis Batsch., clavipes Pers., odora Sow., fumosa Pers., metachroa Fr., fragrans Sow.

Laccaria laccata Scop., var. amethystina Bolt.

Collybia maculata A. & S., butyracea Bull., velutipes Fr., tuberosa Bull., rancida Fr.

Mycena atromarginata Fr. (Mr. Rea from Altyre Woods), rosella Fr., pura Pers., ammoniaca Fr., alcalina Fr., epipterygia Scop.

Omphalia umbellifera Linn., umbratilis Fr.

Pleurotus ostreatus Jacq., mitis Pers., acerosus Fr., porrigens Pers.

Pluteus cervinus Schaeff.

Entoloma erophilum Fr. (new to the British Fungus Flora), Bloxami B. & Br., jubatum Fr.

Clitopilus prunulus Scop.

Leptonia lampropoda Fr.

Nolanea pascua Pers.

Pholiota ombrophila Fr. (Mr. W. Stewart, Drumnadrochit, 24th Sept., 1900), flammans Fr., mutabilis Schaeff., marginata Batsch.

Inocybe hirsuta Lasch. (Mr. Rea, Birnam and Murthly Castle), maritima Fr., fastigiata Schaeff. (Mr. Rea, Birnam), geophylla Fr.

Hebeloma glutinosum Lindgr.
Flammula carbonaria Fr. (Dr. Plowright, Rothiemurchus), inopoda Fr., sapinea Fr., scamba Fr.
Galera tenera Schaeff.
Tubaria paludosa Fr.
Agaricus campestris Linn. var. silvicola Vitt., haemorrhoidarius Schulz.
Stropharia aeruginosa Curt., albocyanea Desm., scobinacea Fr.
Hypholoma capnoides Fr., hypoxanthus Plow.
Psilocybe semilanceata Fr.
Anellaria separata Karst.
Panaeolus campanulatus Linn.
Coprinus comatus Fr.
Bolbitius fragilis Fr.
Cortinarius (Phlegmacium) claricolor Fr., varius Fr., cyanopus Fr., variicolor Fr., largus Fr., multiformis Fr., napus Fr., purpurascens Fr.
" (Myxacium) collinitus Fr., elatior Fr., pluvius Fr.
" (Inoloma) argentatus Krombh., violaceus Linn. (Dr. Plowright). alboviolaceus Fr. (Dr. Plowright), traganus Fr., tophaceus Fr., pholideus Fr.
" (Dermocybe) anomalus Fr., cinnamomeus Fr., var. semisanguineus Fr., orellanus Fr.
" (Telamonia) torvus Fr., armillatus Fr., gentilis Fr.
" (Hygrocybe) obtusus Fr., acutus Fr.
Gomphidius glutinosus Schaeff., viscidus Fr., roseus Fr., gracilis Berk.
Paxillus involutus Fr., atrotomentosus Fr.
Hygrophorus hypothejus Fr.. agathosmus Fr., pratensis Fr., var. pallidus B. & Br., virgineus Wulf., fornicatus Fr., laetus Fr., coccineus Schaeff., miniatus Fr., turundus Fr., puniceus Fr., conicus Fr., chlorophanus Fr., psittacinus Schaeff.
Lactarius scrobiculatus Scop., torminosus Schaeff., turpis Fr., blennius Fr., hysginus Fr., vellereus Fr., deliciosus Fr., theiogalus Fr., vietus Fr., rufus Scop., glyciosmus Fr., mitissimus Fr.
Russula nigricans Fr., olivascens Fr., furcata Fr., drimeia Cke. (expallens Gillet), rubra Fr., vesca Fr., foetens Fr., fragilis Fr., puellaris Fr., alutacea Fr.
Cantharellus cibarius Fr., aurantiacus Fr., umbonatus Fr. (Murthly Castle), infundibuliformis Fr.
Marasmius oreades Fr., erythropus Fr.
Lentinus lepideus Fr., cochleatus Fr.
Boletus luteus Linn., elegans Schum., flavus With., bovinus Fr., piperatus Bull., variegatus Sw. chrysenteron Fr., subtomentosus Linn., radicans Pers., edulis Bull., luridus Schaeff., versipellis Fr., scaber Fr.
(Gyrodon)? sp.

Stobilomyces strobilaceus Fr. (Mr. Rea, Murthly Castle).
Polyporus Schweinizii Fr., perennis Fr., fragilis Fr., destructor Fr., amorphus Fr., betulinus Fr., annosus Fr., versicolor Fr., abietinus Fr.
Trametes pini Fr.
Merulius pallens Berk.
Hydnum imbricatum Linn., fragile Fr., repandum Linn., compactum Pers., aurantiacum A. & S., ferrugineum Fr., scrobiculatum Fr., zonatum Batsch., nigrum Fr., melaleucum Fr., auriscalpium Linn.
Sistotrema confluens Pers.
*Thelephora Sowerbeii B. & Br.=Stereum Sowerbeii Massee., laciniata Pers.
Exobasidium vaccinii Woronin.
Stereum purpureum Pers., hirsutum Fr., rugosum Fr., sanguinolentum Fr.
Corticium sanguineum Fr.
Sparassis crispa Fr. (Mr. Stewart, Drumnadrochit).
Clavaria amethystina Bull., cinerea Bull., cristata Pers., abietina Pers., flaccida Fr., stricta Pers., inaequalis Fl., Dan.
Calocera viscosa Fr.
Naematelia encephala Fr.
Rhizopogon luteolus Pers.
Lycoperdon gemmatum Batsch., pyriforme Schaeff., perlatum Pers., caelatum Bull., nigrescens Vitt.
Cudonia circinans Fr.
Helvella lacunosa Afzel., elastica Bull.
Spathularia clavata Sacc.=flavida Pers.
Humaria violacea Sacc.
Rhizina inflata Quélet.
Cordiceps ophioglossoides Fr. on Elaphomyces variegatus Vitt.
Spumaria alba D.C.

* Dr. Plowright does not assent to this determination.

THE NUTRITION OF FUNGI.

BY H. MARSHALL WARD, Sc.D., F.R.S., F.L.S. F.R.H.S.;
Fellow of Sidney Sussex College, Honorary Fellow of Christ's College, and Professor of Botany in the University of Cambridge.
Honorary Fellow of the Manchester Literary and Philosophical Society and of the Botanical Society of Edinburgh.

PRESIDENTIAL ADDRESS.

Ladies and Gentlemen,

We are told that there are at least 40,000 to 50,000 species of Fungi, some say more. As to the accuracy of the census I cannot decide, but the ponderous fact obtrudes that some people have taken charge of this vast family, and undertake to recognise and name many of them and to have a nodding acquaintance with the rest. True, the recognition and naming are frequently done with the aid of photographs, drawings and measurements, etc., as is done in the case of higher organisms with the aid of portraits, anthropometric devices, Galton's finger-prints, etc., but the astounding fact remains that some of my friends can identify hundreds, if not thousands, of these Fungi at sight, and if they do hesitate occasionally as to whether a given species of *Lactarius* is *L. theiogalus* (Fr.) or *L. subdulcis*, *L. serifluus* or *L. quietus*, or whether a doubtful *Mollisia* is the true *M. cinerea* (Batsch) or one of the numerous forms that may have been mistaken for it, they adopt the honest and sensible plan of submitting the question for discussion and reference to the *Transactions of the British Mycological Society* and other works of authority and repute.

Personally, I must confess to a profound admiration of the powers of close and astute observation, and retentive memories for details of these friends of mine, as well as to an utter inability to emulate their confidence in the field, and were it not that I have frequently had occasion to test these powers in most enjoyable rambles in pursuit of Fungi in their natural haunts, should have been much more sceptical of its being possible to attain such confidence.

With these convictions, you will scarcely wonder if I hesitated to incur the responsibility of addressing you in my present capacity, and deeply sensible as I am of the honour of being your president, it is

only on the grounds that we are all interested in all that concerns Fungi that I accepted, knowing that while those aspects of Mycology which most concern me at present must be of interest to you, you will be able to teach me far more than I can pretend to offer in return.

A fungus spore contains but a minute fraction of the food-materials required by the mycelium which developes from it under suitable conditions, and we know that additional supplies must be provided from outside. Moreover, we can trace the destruction and disappearance of the constituents of the food supplied as the mycelium grows, and analyses show that it is especially organic carbon compounds which are accumulated in the growing fungus.

Experiments prove that in no case does this nutrition consist in a mere transference of substances absorbed from the food medium into the body of the fungus : on the contrary, profound and complex changes must occur before the substance of the food becomes substance of the fungus, and these changes are often accompanied by great waste of materials.

The kinds of changes most in evidence are as follows. The food-substances must be rendered soluble and in a fit condition to be absorbed in solution, and this frequently entails alterations brought about by the fungus itself or by some body excreted by it—*e.g.*, the inversion of non-assimilable sugars (Yeast), the saccharification of starch (*Aspergillus*), the softening of horn (*Onygena*) or wood (*Stereum*), and so forth.

Then we find that when the food-stuffs have been absorbed, still more profound chemical decompositions are undergone inside the cells of the fungus. The atoms and molecules are re-arranged and re-distributed in various ways, and never wholly as they were at first. Some of them are temporarily built up into the living structures, only to undergo still more turbulent and disturbing redistributions; some combine with oxygen and are burnt off in respiration; some are finally brought into a condition of comparative rest in the so-called permanent structures of the fungus—*e.g.*, the cell-walls—while others are left to wander here and there, inside or outside the arena of stormy life-activity, and ultimately attain a condition of rest—again only comparative—it may be in union with other vagrant molecules, in the form of some substance not wanted by the plant.

Meanwhile, substances resulting from the various chemical changes referred to, pass out of the fungus into the external world, and may in their turn produce secondary series of alterations on the food medium—may even poison it, in fact—and the now altered food may re-act again on the fungus.

It is in the province of physiology to describe and explain these various phenomena of absorption, conversion, constructive and destructive metabolism and excretion; to show how they are linked together in life-actions, and to discover how the living substance of the fungus is built up and broken down, and how it is enabled to perform those remarkable evolutions we term life.

Now, while we may as well frankly admit that there is not the slightest expectation as yet of any immediate realisation of the latter object—and the intensity of expectation on the part of more sanguine individuals need no more deter us from this admission than the apathy or scepticism of others need exclude the hope that it will one day be attained—it is, on the other hand, clear that great and important advances in our knowledge of the possibilities and meaning of life-actions have been made during the last quarter of a century, and particularly from the study of the Fungi. Certain questions arising herefrom seem to me worth examining by a combination of field and laboratory mycologists.

Analyses have shown that in addition to traces of numerous elements shown to be un-essential to its life, a fungus, freshly gathered, contains about 85-90 °/o of water, and 10-15 °/o of solids. It was then found that in all cases the solid material consists of a combustible portion—about 10-12 °/o of the fresh fungus—yielding Carbon, Oxygen, Hydrogen and Nitrogen, chiefly in the form of Carbon-dioxide, Water and Ammonia, when burnt, and a residual ash —about 1-2 °/o of the whole—containing potassium, phosphorus, magnesium and sulphur, together with traces of calcium, sodium and other minerals.

As experience progressed it was found possible to add that in the intact fungus the elements referred to are combined into Carbohydrates, proteids, fats and traces of other bodies, the minerals being in some way distributed among these so-called organic compounds, but how it was impossible to say.

It was then found that a certain elasticity is observable in the proportions of these elements, and that, while it is generally true that the combustible part contains 50 °/o Carbon, 30 °/o Oxygen, 15 °/o Nitrogen and 5 °/o Hydrogen, for instance, even one and the same fungus contains different proportions of these and of water and of ash at different stages, in different situations, and in its various parts. Thus the proportions in that well studied fungus, *Saccharomyces*, contains, per cent. of dry weight—

Carbon	... ...	47	to 50·8
Hydrogen	... ...	6·5	to 7·3
Nitrogen	... ...	9·2	to 15
Oxygen	... ...	31·4	to 37·1
Minerals	... ...	2·5	to 9

And a recent analysis of *Penicillium* gives, in the mycelium, 12·36 °/o of dry solids, of which 11·34 °/o is ash; whereas the spores yield 61·13 °/o of solids, of which only 3·09 °/o is ash.

Again, *Agaricus melleus*. 16·26 °/o of its dry weight are proteids in the fully grown specimens, but in the young state the pileus yields 28·6 °/o and the stipes 26·91 °/o, and similarly with other Fungi.

Another remarkable point is the large proportions of potash and phosphoric acid in the ash of Fungi, these valuable elements often

amounting to 80 or 90 °/o of the total ash. A recent analysis of *Aspergillus* spores, for instance, gave 45·96 °/o of potash and 39·64 °/o phosphoric acid. This is noteworthy, because it is just these minerals which are apt to be rare in soils, or at least only accumulated with great difficulty by plants.

It soon became evident, however, that these destructive analyses of Fungi would never enable the physiologist to understand how the various chemical substances exist in the plant, and that we might as well expect to understand the construction and working of a watch by smashing it up in a mortar and dissolving it in acids, as hope to apprehend the structure and functions of the fungus by these drastic measures; and although numberless delicate investigations continued to show that very curious and interesting chemical compounds can be obtained from Fungi—*e.g.*, the poisonous alcaloids, Muscarin from *Amanita muscaria*, Ergotin from *Claviceps purpurea*, and the long series of brilliant colouring matters and organic acids, and of carbo-hydrates, resins, etc. from Lichens and various Fungi—little progress was being made towards a solution of the principal problems.

It was clear that every fungus contains the elements mentioned; but it was by no means proved that all are necessary. Obviously the only way to decide the matter was to cultivate the fungus and offer it these elements in various proportions, and see whether and how it can build up its substance in each case.

Now there are hundreds of ways of presenting such elements to a growing fungus. It is very easy to make up doses of substances such as calcium carbonate, potassium sulphide, magnesium phosphate, sodium nitrate, etc., in water, but although such a mixture would contain all the elements required, it was soon found that no fungus would grow in it, and that the form in which the elements are combined is an essential point in the food of Fungi. Many trials led to the conclusion that the carbon especially must be presented in particular forms, as otherwise the fungus cannot avail itself of the supply, and this was soon explained when the consequences of the lack of chlorophyll were understood. But it was also found that the nitrogen constituents must also be presented in special forms, or the fungus could not flourish: for instance it is as a rule useless to offer nitrates. And as experience accumulated similar facts came out in other connections.

An excellent food-mixture for many Fungi was then shown to be such as the following.

Ordinary cane-sugar, as the principal source of the carbon; ammonium tartrate, supplying nitrogen, and the ashes of yeast, containing the necessary mineral elements; the oxygen and hydrogen needed being also afforded by the organic materials and water. Many other similar mixtures were also used successfully. But several curious and instructive discoveries soon resulted from culture experiments in such media.

It was found that the cane-sugar is first altered by the fungus and broken up into two other sugars—fructose (levulose) and glucose

(dextrose)—of quite different kinds before being absorbed. It transpired, for instance that the fungus *Saccharomyces* cannot absorb and digest cane-sugar itself until it has been thus broken up. This then was the first point, that the fungus has to so alter this particular sugar into two others easily assimilable by it before it can begin feeding, and it is now known that it does this splitting—hydrolysis—by means of an enzyme which it excretes into the medium.

The next point was that the carbon, hydrogen, oxygen and nitrogen and the mineral matters did not appear in the new fungus, built up by assimilation and growth, in anything like the same forms or proportions in which they were presented. For instance, no ammonia or tartaric acid or sugars were to be found in the fungus, or even in the unemployed food-medium at the end of the experiment. It took a long time to show what changes had occurred, and, put shortly, they were as follows. Certain quantities of the carbon, hydrogen and oxygen, and most of the nitrogen had been built up into the protoplasm of the cell; some of the carbon, hydrogen and oxygen had been converted into the substance of the cell-walls, while a little had gone to form fats; and traces of the mineral matters K., P., S. and Mg., had been retained in some way in the structure of the cells. But far larger proportions of the carbon, hydrogen and oxygen had not been used by the fungus at all—they had been converted into alcohol and carbon-dioxide, with traces of organic acids and glycerine in the liquid outside the fungus, and appear never to have gone into the fungus at all. The second and third points eventually established then were, that while none of the chemicals employed as food had been annihilated or lost, all had been altered; a certain proportion had gone to form new fungus-substance, but far more had been broken up and changed in the external medium. And this, of course, altered the medium itself as a source of food supply. The last of the four points here concerned was not thoroughly demonstrated until some time after. It is that although the sugars named are such excellent media for supplying the most of the carbon, hydrogen and oxygen required by the *Saccharomyces* known as Beer-yeast, and there are one or two other kinds of sugar it can also digest and assimilate; it starves if we attempt to feed it on other sugars. For instance, milk sugar (Lactose), though it contains carbon, hydrogen and oxygen in the same proportions as does cane-sugar,* is sweet and an excellent food, yet our yeast-fungus will starve if this is its only source of carbon. Now what explanation can we give of this ?

It is not because Lactose is useless to all Fungi; because another species of yeast (*Saccharomyces acidi-lactici* is known which flourishes perfectly well in it. A clue is obtained when we recall the fact that our fungus cannot directly assimilate cane-sugar, and add that certain other simple Fungi—*e.g.*, *Monilia candida*—can do so. One reason

* Strictly speaking

Cane sugar $= C_{12} H_{22} O_{11}$

Lactose $= C_{12} H_{22} O_{11} + H_2 O$

our *Saccharomyces cerevisiae* cannot utilise milk sugar as its source of carbon, then, is because it cannot split it up—*i.e.*, hydrolyse it—into the simpler assimilable sugars as it can cane-sugar. It can excrete the enzyme—invertase—necessary to alter the cane-sugar, but it cannot form the enzyme—lactase—which would hydrolyse the milk-sugar. If it could perform this preliminary splitting up it would be perfectly well suited by feeding on the resulting glucose, as is proved by the fact that if we put our yeast into a solution containing milk-sugar together with another fungus which *can* break up this sugar, the former flourishes admirably.

This theme is so important that I must risk taxing your patience by adducing one more example. Suppose in the nutritive solution for our fungus we substituted Starch for sugar. Here we should be putting a compound of C. H. and O. where again the proportions are not remarkably dissimilar*, and, as we know, starch is an admirable food-stuff even for many Fungi—*e.g.*, *Eurotiopsis*, *Aspergillus*, *Mucor*, *Penicillium*, etc.—we may be surprised to find that our fungus may starve apparently in the midst of plenty; here, again, it is found that this is simply because the yeast cannot actively† alter the starch into assimilable sugars, for if we put in another fungus—*e.g.*, *Eurotiopsis Gayoni* or *Aspergillus Oryzæ*, which excretes abundance of diastase and quickly hydrolyses the starch to glucose, the yeast then flourishes admirably. Numerous other examples of the same kind can be given from among the Fungi, and there is no doubt as to the general application of the principles I have here illustrated by reference to simple and well studied cases, for it must be remembered that wood-fungi, leaf-fungi, etc., all need sugars and similar bodies.

It is evident, then, that in providing for the nutrition of a fungus, it by no means suffices to give it simply the necessary food-elements. The form in which these elements are combined in the food is a matter of fundamental importance. But experimental enquiry—and, as we see, the whole question is one of experiment—has resulted in the further discovery that great differences exist in the food requirements of different Fungi, even within the limits of suitable food-media, and there can be no doubt that it is as important for an Agaric to obtain the right mixture as it is for a Mould to do so.

Ordinary saprophytic mould-fungi, *e.g.*, *Mucor*, *Penicillium*, *Aspergillus*, etc., will grow admirably on such a medium as the following:

Sugar	15 grams.
Peptone	1 „
Di-potassium phosphate ($K H_2 P O_4$)	0·2 „
Magnesium sulphate	0·04 „
Calcium chloride	0·02 „

Or, employing the same minerals, we may offer the carbon and nitrogen, etc., in the form of leucin and sugar, or ammonium tartrate and sugar, or peptone alone or leucin alone, or asparagin, or am-

* The formula for starch is $xC_6 H_{10} O_5$.

† I say actively because some varieties of yeast can slowly excrete a little diastase.

monium acetate, with the result that growth occurs but is worse and worse as we go down the list. A still more accurate series of results is got by using ammonium nitrate as the source of nitrogen throughout—of course with the minerals also—and varying the source of carbon. The growth will then be found to be worse and worse as we go down the following list. Grape-sugar, cane-sugar, peptone, albumen, quinic acid, tartaric acid, citric acid, asparagin, acetic acid, butyric acid, ethyl alcohol, benzoic acid, propylamine, methylamine, phenol, formic acid.

That any fungus should be able to grow at all in some of these media is remarkable enough, and it should be noted that most of the lower numbers on the list are utterly useless to most Fungi.

Further research has shown that these common moulds can secrete various kinds of acids and enzymes, and their universal distribution and adaptation to all kinds of food-materials (heterotrophy) evidently depend on these powers. Their occurrence in the chemicals of druggists' shops, even in solutions of arsenious acid, picric acid, copper-sulphate and other poisons, the power of penetrating wood which I have shown *Penicillium* to possess, and the existence in them of proteolytic, diastatic, inverting, and other enzymes which attack proteids, cellulose, sugars, fats, etc., all go to explain their ubiquity.

What a different case seems to be presented when we turn to a parasitic fungus such as a Uredine, or other form which can only live on some special host-plant and cannot be cultivated in artificial media.

And yet the difference is more in degree than in kind, for recent researches have convinced us that the parasite contains and requires the same elements and compounds as the saprophyte, only it has had to adapt itself to certain peculiar difficulties in obtaining it.

I might perhaps compare the roving saprophyte to a vagabond in a land of plenty where, his tastes not being fastidious, he finds abundance of suitable food lying around, as our cousins say, on all hands, to be picked up without restraint; whereas the parasite has been so long used to having his food highly prepared and specially served that, although he has to enter stomata, pierce cell-walls and cause all sorts of locks, bolts and bars to fall asunder before he can get at the stored and manufactured tit-bits in the cells attacked, we must regard him as a sort of aristocrat—a burglarious aristocrat, if you like, but a highly bred and fastidious individual nevertheless.

It seems at first as if immeasurable differences separated these parasites from the ubiquitous moulds, but closer investigation raises suspicions as to the validity of such a conclusion. On the one hand it has been shown that if we inject a little sugar into a living leaf, so that an excess of this dainty is presented, even so irreclaimable a saprophytic vagabond as *Penicillium* will creep through the stomata and penetrate the leaf-passages, behaving to all intents and purposes like a parasite; moreover, it will enter the medullary rays and other tissues of wood under certain circumstances quite like a timber-parasite. Nay, it is possible to induce *Penicillium* and *Aspergillus* to penetrate epidermal cell-walls or even artificial cellulose membranes

on the other side of which an attractive food-material such as a sugar has been placed, so that our saprophyte here not only turns towards the membrane, but excretes a solvent enzyme and dissolves its way through it, and so gets at the sugar just as a parasite would do. On the other hand many parasites can be easily cultivated for years in artificial media—*e.g.*, Ustilagineæ. Yet even these very mould-fungi so remarkable for their omnivorous heterotrophy exert, so to speak, a distinct choice when two or more carbon compounds are offered them together, as shown by the fact that *Penicillium* is employed by the chemists to split racemic compounds. In other words, if *Penicillium* or *Aspergillus* is offered tartaric acid as a source of carbon, it splits this into its optically positive and negative varieties, and so long as there is optically positive acid present the fungus leaves the other variety severely alone.

Again, although *Aspergillus* can feed on glycerine, it will pick out the smallest traces of dextrose from a mixture with glycerine before attacking the latter, whereas it prefers acetic acid to dextrose in a mixture of these two although acetic acid itself is, like glycerine, a poor food.

Again, *Eurotiopsis Gayoni*, a most remarkable fungus found on boiled starch, can obtain its carbon from Dextrose, Levulose, Maltose, Lactose and numerous other such substances, and yet is totally incapable of utilising cane-sugar or Inulin, notwithstanding the close relationships of these carbo-hydrates to sugars and starches.

Many other instances can be given where a fungus selects one substance in preference to another, although the latter may be the better food-material as judged by the general behaviour of organisms towards it.

Such considerations, and numerous experiments based on them, lead to the conclusion that we cannot classify or arrange the food-materials of Fungi according to any chemical or physical scheme. Nägeli's conclusions that compounds containing C. and O. directly connected could not be assimilated, and that C. H. groups are useless unless two or more atoms of carbon are linked together, were alike premature and inaccurate, as shown by the feeding of certain Fungi on formic acid or methyl alcohol, each containing but one C. atom. Equally is it impossible to estimate the nutritive value of a food-material according to its calorific value, otherwise fat ought to be always a better food than glue, and cane-sugar better than either, whereas, as I have recently shown, *Onygena equina* refuses both fat and sugar, and demands the glue, and *Phycomyces nitens* revels in fatty oils, as was well exemplified by the enormous growths of that fungus I saw at a burnt oil mill last winter. The fact stands out plainly that we do not know what decides the nutrient value—*i.e.*, the smallest quantity of carbonaceous substance consumed by unit-weight of plant in unit of time—of any carbo-hydrate or other organic substance, and must conclude that the protoplasmic activities are so attuned to particular food-supplies that they refuse to readily change their habits—I say *readily*, because we know of many cases where a fungus can be

gradually accustomed to new food-substances. It is interesting to note in this connection an observation of Brefeld's, which I have also confirmed, viz., that spores of coprophilous agarics which can only be got to germinate in dung-decoctions, will, when a vigorous mycelium is once started, go on growing in other food media, and other examples of the same kind are not uncommon. Thus we may have Fungi incapable of parasitism until the spores have been germinated in dead media, as I showed to be the case in the Lily Disease due to a *Botrytis*.

It appears to me that the foregoing evidence—which can be largely extended—leads to the following argument. Since the principal destiny of all the essential food-materials is to build up the protoplasm of the fungus, and since the whole of the structural peculiarities of the fungus result from the activity of the protoplasm, we must conclude that if two individual mycelia of the same species are being fed in different ways, from different sources which supply the essential constituents in different combinations, the working of the protoplasm must vary in each case, and if the protoplasm varies, the results of its activity must vary also. It does not follow that the resulting variations will be visible to us, though it can be shown that they often are visible; nor does it follow that we can predict what the variations will be, though the purely experimental enquiry, which alone can decide such matters, shows that even this can now be done to some extent, as we shall see.

The point to be emphasized for the moment is merely that if we vary the nutrition of the protoplasm—and we see this can be done within certain limits—then we vary its activities, and among such activities are results of the highest importance to the present argument, some of which may be such as our senses take cognisance of, though others will be too subtle or too transient to be noted by us.

If to variations of food-supply we add variations in the other conditions of life-activities—*e.g.*, temperature, moisture, concentration of food-materials, illumination, aeration, etc.—all of which are known to induce changes of importance, we see dimly down long vistas of possibilities, and the wonder is not that Fungi vary, but that any species is able to maintain its average standard of peculiarities and properties. Here, however, we open up questions into which there is not time to enter, and I must pass on.

If I now cast a glance at some of the curious cases of habitat and food-supply known, it must necessarily be brief and only serve to remind us of examples.

Mycophthorous Fungi are by no means uncommon. *Polyporus agaricinicola* (Ludw) on *Amanita*, *Boletus parasiticus* (Bull) on *Scleroderma*, *Volvaria Loveiana* on *Clitocybe nebularis* and the well-known cases of *Nyctalis*, *Hypomyces*, *Hypocrea*, *Cordyceps*, *Barya*, etc. etc., are cases in point.

Carbonicolous species are also abundant, as exemplified by *Flammula carbonaria*, *Cantharellus carbonarius*, *Ascobolus carbonarius* and other pezizineæ; the well-known *Peziza omphalodes* (*P. confluens*)

has turned up regularly in my laboratory during the last two years on the sterilised pots of soil used in Dr. Dawson's experiments.

The still mysterious outbreak of *Peziza aurantia* on gault clay taken from a pond in the Cambridge Botanic Gardens, described by me a short time ago, is another case in point.

Several Fungi are found on oil and fats, and Mr. Biffen, working in my laboratory, showed that a true destruction of the fat occurs. *Monascus* was found by Went on the glycerine of soap-works. *Phycomyces*, *Inzengæa* (*Emericella*) and *Cyclonium* are other examples.

The destruction of horn, feathers and similarly strikingly resistent substances by *Onygena*, *Ctenomyces*, *Ascobolus*, is even more remarkable; and I need hardly refer to the numerous coprophilous species of *Coprinus*, *Anellaria*, *Panæolus*, *Ascobolus*, etc., some of them apparently specifically peculiar to the excrement of particular animals, a point of some significance, in my opinion.

The idea seems to be wide-spread that Fungi are not common on animal substances, but apart from the cases mentioned, let me remind you of the now very long list of parasitic and semi-parasitic forms which attack insects; recent investigations render it probable that a very serious—to the Locust—epidemic disease of Locusts is due to a *Mucor*, and every mycologist is familiar with the entomophagous species of *Empusa*, *Entomophthora*, *Tarichium*, *Cordyceps*, *etc.*

Protozoa, Cœlenterata, Infusoria and other lower animals have numerous fungus enemies among the Chytridiæ and Phycomycetes. Nematode and other worms are preyed on by species of *Harposporium*, *Monospora* etc.

Fishes, Birds and higher Vertebrates also have numerous fungus parasites, of which the *Saprolegnia* of salmon disease and the *Aspergillus* and *Mucor* of lung mycosis, and the Fungi of "Ring-worm" and other diseases are best known. But even more serious affections of man and higher animals are due to Fungi, and recent investigations are bringing forward the question whether that dreaded disease, Cancer, is not due to the invasion of the tissues by a true fungus.

This must suffice, however, as there is not time to extend our list to cases including wasp's nests, honeycomb, resin, wall-papers, corks, sacking, rope, etc., as curious habitats for Fungi. Moreover, you will be able to add numerous examples yourselves.

Several questions arise from such considerations as the foregoing. How do Fungi get nutriment from such insoluble materials as feathers, insects' wings, honeycomb, wood, etc.? Are the peculiar forms found on such media permanent species, or adapted races, or varieties, on which the special conditions have had effect? Do the same species grow on several such peculiar habitats, and what determines their success on one and not on another? Why do we find a particular fungus on the dung of a particular animal, and not on that of an allied animal? Do all the spores which fail to come in contact with this peculiar medium perish; or do they give rise to sterile mycelia; or—most fateful of questions—do we give different specific names to

the same fungus growing on different media and in different conditions ?

This last question is vital, and I propose to examine it a little more closely. You are aware of the excitement which arose when the polymorphism of the Fungi, as it was termed, was first brought forward by the Tulasnes and followed up with such critical acumen by De Bary and his school. We now look on the then marvellous cases of *Sclerotinia, Eurotium, Puccinia* and many other instances with equanimity, and smile at the wild dismay of the mycologists of those days who could not see the trend of events, and that much of this polymorphism was of the same order as we should institute by having different names for corn in the blade and corn in the ear. Much more subtle are the cases with which Eriksson has now familiarised us—the varietal forms or races of *Puccinia graminis*—or which Hansen has shown to exist in the cultivated yeasts. These must be put at the other extreme as cases of, not polymorphism—because we cannot perceive the differences in form—but polyergism, if I may coin the term to express their salient features of differences in physiological activity.

Between these two extremes we are beginning to recognise that there exists a kind of polymorphism in which direct effects of nutrition are observable, and not mere differences of developmental stages.

Plenty of instances can be given of the direct effects of nutrition. Brefeld showed that if you go on growing an *Ustilago* in certain nutritive media it yields nothing but yeast-forms for months and years, and no one would suspect these to have anything in common with the *Ustilago* developed on a cereal.

Planchon's recent investigations on the effect of food-materials on *Dematium* and other Fungi lead to the same conclusions. I have myself shown quite conclusively that *Dematium pullulans* may develope in the form known as *Coniothecium* on pine sawdust, as a *Torula* on certain other solid media, as a *Yeast* in certain liquids, while the typical *Dematium* condition is regularly maintained on saccharine gelatine media, all at ordinary temperatures and growing side by side.

Equally conclusive are the remarkable results recently published by Klebs, showing that the reproduction of Fungi, and the kind of spore produced, depend in the first instance on definite conditions of nutrition. Klebs showed that it is possible to take a fungus, such as *Saprolegnia*, and cultivate it for months, and even years, on a suitable food-medium, where it grows admirably, but never produces either zoosporangia or oogonia. Klebs found that if he sowed this fungus on the following medium,

Gelatine	...	...	5 grams
Extract of Meat	...	...	2 grams
Tap water	...	...	93 cu. cm.

it grows admirably, and in two or three days formed an abundant mycelium. The same result was obtained if a bit of this sterile mycelium was transplanted by means of a needle into a solution made by boiling 5 peas in 50 c.cm. of tap water.

If a bit of this mycelium was transplanted every third day to a new vessel of the pea-extract, it also grew rapidly to a rich mycelium, and this was done repeatedly for two and a half years with the same result —not a trace of either zoosporangia or oogonia was developed; the mycelium remained completely sterile the whole time.

Yet at any period during this two and a half years it was only necessary to put a bit of the sterile mycelium into tap-water—*i.e.*, to suddenly starve it—and in a few hours it developed abundance of zoospores, whereas if he put such a piece into Agar (a gelatinous or gum-like substance obtained from certain sea-weeds), it immediately proceeded to form oogonia. If, again, the well-nourished sterile mycelium is put into 1 °/o salt solution, it forms neither zoosporangia nor oogonia, but at once developes gemmæ, *i.e.*, resting bodies consisting of jointed bits of the mycelium in which the protoplasm collects.

It would take much too long to describe all the experiments, or the precautions and proofs which led step by step to these results, but I cannot forbear just adding the explanation they give of ordinary experiences in our laboratories. When I want a stock of *Saprolegnia* for teaching purposes I float a few dead flies, black-beetles or meal-worms on water; the dead bodies slowly diffuse peptone-like substances into the water and a rich mycelium rapidly radiates out from each. As long as the food-material is abundant the mycelium remains sterile; as the outflow of food-substances diminishes, however, owing to the extra demands of the enlarging mycelium, the distal ends of the radiating hyphæ begin to form zoosporangia in the less nutritious solution into which they are forcing themselves. As time goes on the starvation of the mycelium proceeds further, and now the oogonia begin to appear in those hyphæ which find too little food for zoospore-formation let alone growth.

Time will not admit of even a recapitulation of similarly decisive experiments with *Mucor*, *Sporodinia*, *Eurotium* and other Fungi, but I may remind you that we proceed quite similarly with the fungus *Saccharomyces* (Yeast). When we want spores for class demonstration we simply take well nourished sterile yeast cells, put them on a wet porous porcelain plate, and in 24-48 hours the starved cells begin to develope spores.

One striking experiment with *Sporodinia*, which developes its sporangia in air, not in water. If a strong culture is placed in each of two similar vessels, and you keep one covered by a glass plate and one open so that the evaporation partially dries the air, the latter developes sporangia and the former zygospores. Nay, if the culture is large enough and properly disposed, you can keep half the air relatively dry by moving the cover-glass so that only part of the culture is covered, and in the drier region sporangia will develope and in the wetter region zygotes. In this and similar cases the starvation necessary to spore-formation is graduated by the transpiration which the sporangiophores exhibit. Stop this, and the change in nutrition

of the hyphæ impels them to form zygospores; promote it, and they develope sporangia.

In other words, the nutritive conditions decide not only the mode of reproduction, but also whether it shall form reproductive organs at all, and this quite apart from any injury to the growth, which is often more vigorous if sterile.

Now, it is clear that although we do not know all the stages of these processes—for instance, we are profoundly ignorant of what substances pass from the mycelium into the sporangiophores and zygophores—a great step has been made in establishing, as Klebs has done, that definite conditions of nutrition are concerned in bringing about the reproduction processes, and in modifying their characters. The mere fact that in *Penicillium*, for instance, the spores contain, according to Kramer's analyses, 61·13 °/o of dry substance containing 3·09 °/o of ash, as against 12·36 °/o and 11·34 °/o respectively in the mycelium, shows that enormous changes in substance occur when the living protoplasm is impelled to produce spores, and the great accumulations of fat, nuclei, etc., in other reproductive bodies tell a similar tale. Whether we shall ever learn exactly what occurs must be left to the future, but it is obvious that the present steps in the enquiry are essential to enable us to set the further questions to be answered.

One of these questions is, how far is the development of the pileus, spores, etc., of a hymenomycete dependent on the nutritive conditions? Another is, do the conditions affect the characters of these organs? The matter is important, because we determine the species entirely from these characters.

The question now arises, Can we apply the preceding considerations to the higher Fungi, such as the Hymenomycetes?

In so far that genera and species are still accepted which are merely immature or arrested conditions of forms placed in other genera and species when complete, there can be no doubt of it. I propose myself to show you that *Naematelia* is merely an abortive state of *Tremella*, and other cases of the kind can be adduced.

In so far, also, that considerable variation occurs in the higher agarics, etc., we have grounds for raising the questions I am raising. I need only remind you of the well marked varieties of the common Mushroom both in cultivation and in the field; and at the risk of an uplifting of the eye-brows on the part of you masters of the Friesian Mycology, I venture to put to you whether the characters which differentiate extreme varieties of *Psalliota campestris* are not as striking as those which distinguish this species as a whole from *P. cretacea* (Fr) *P. silvicola* (Vitt), *P. arvensis* Schæff and *P. sylvatica* Schæff) *?*

Plenty of other instances can be selected from among those agarics which have been sufficiently studied. *Armillaria mellea* is a case in point. A good authority has said of it, "There is scarcely a plant more apt to assume different aspects under different conditions than the present one," a statement we can all confirm; and that exquisitely

beautiful species, *A. mucida*, varies from diaphanous white to olive and even black.

Marasmius androsaceus has two varieties at least, one on oak-leaves, the other on pine.

What should we do with a *Pleurotus*, the spores of which show traces of brown or lilac-pink ? Ask those who have had to do with *P. euosmus* or *P. salignus*, etc. The very same thing has occurred in *Marasmius*, several species having yellow or ferruginous spores, and Scherffel has separated these off as a genus *Phaeomarasmius*. Or let me take the group of species allied to *Hygrophorus conicus*, viz., *H. chlorophanus*, *H. psittacinus*, *H. coccineus* and *H. puniceus* : are we certain of these as species, or have we here a series of prismatically coloured forms growing on different media and in different situations and varying accordingly ?

Or, again, let me direct your attention to that group of species and varieties of which *Hypholoma fasciculare* and *H. sublateritium* are the type. Does not *H. sublateritium* with its varieties *Schaefferi* and *squamosum* merge into *H. fasciculare* and its variety *elæodes* ; *H. capnoides* and *H. epixanthum* coming into the alliance ? Has anyone worked here at the connection between form, colour, texture, etc., and the kind of wood and situation the fungus grows on and in ? I ask, because it has appeared to me that those growing on Conifers, on Oak, and on other stumps seem to differ.

Similar questions may be raised concerning *Collybia velutipes* and its allies; and an analysis of *Russula*, *Clitocybe*, and other genera and sub-genera afford numerous other examples.

Need I go further in citing these mycological puzzles ? Enough has been said to show that any exact knowledge of the nutrition of Fungi must count for good in the arduous task of elucidating the many and perplexing vagaries of these elusive organisms. Of course, if we choose to push the definition of a species as merely " the unit in classification designating an assemblage of organisms which, in the judgment of any writer, is so marked and so homogeneous that it can be conveniently spoken of as one thing," then it may be argued that there are as many species as there are opinions ; but it is obvious that some consensus of opinions must be arrived at if we are to have species which can be *conveniently* accepted, and what I am advocating is that the accepted species must as a mere matter of convenience be more broadly defined—not that their variations are to be ignored or denied, which would be absurd.

It does not seem likely that the more prominent morphological features, such as the mode of spore-formation, the arrangement of basidia, gills, etc., would be affected by differences in nutrition, because experience shows that when once the so-called morphogenic impulses are started, the species appears to carry them to their normal conclusions ; but it does appear very likely that such characters as texture, colour, size, excavations, compactness, viscidity, silkiness and numerous other minute characters known to be extremely variable under different conditions in other plants, may be equally incidental

in the Agarics. For we must not forget that the pileus, etc., is not a sexually developed organ; it is subject to all the so-called somatic influences that affect any vegetative structure.

It should not be overlooked, however, that conditions of growth may affect even such points as the shape of the hymenophore, as shown by Massee in *Stereum hirsutum*, in *Pleurotus*, etc. Patouillard has described a specimen of *Psalliota campestris* with cross-connected gills resembling one of the polyporei, and similar anomalies have been described in *Amanita*, *Pleurotus*, *Coprinus*, etc., and are normal in *Favolus*, *Lentodium*, *Marasmius*, etc. These cases are, of course, not to be confounded with those caused by parasites—*e.g.*, *Lactarius*.

Nor are spores exempt. Horrell has shown that the number of basidiospores in Mushrooms vary from two to four, and Brefeld and Klebs find that if the chlamydospores (macro-conidia) of *Hypomyces chrysospermus* develope in air they are covered with spike-like asperities, but if formed in a liquid they are smooth, and Biffen observed similar effects of the environment on the spores of *Acrospeira* in my laboratory. I showed long ago that *Didymium*, which has white calcified spore-cases if growing in air, loses the lime and forms black sporangia in water, and Klebs has confirmed this and shown that differences in the capillitum and stalk also result.

I do not propose to insist on these cases, however, further than to point out that it is evident we must be cautious in assuming that any characters such as those under discussion are sacred from the all-pervading influence of conditions. It has been estimated that while 30 % or so of the Agaricini grow on wood, the vast majority—about 64 % of the British species—are developed in the ground, a vague term, since it includes old charcoal beds, decaying sawdust, humus, etc., and observation shows that peculiar conditions are associated with many species. Everyone knows that the Agarics of a Beech-wood differ from those of a Pine-forest, and that many species found in pastures are not gathered in shaded situations. But more curious points arise. Why is *Amanita muscaria* so partial to the neighbourhood of Birches and Conifers; and why is *Marasmius oreades* only found among grass? I once traced the mycelium of the latter to the roots of the herbage among which it grew, and I have lately had *Stropharia aeruginosa*, a form not uncommon in pastures and woods, parasitic on the roots and rhizomes of an *Asparagus*, a point of some interest since Brefeld failed to cultivate this fungus from its spores.

These cases are not without interest in connection with the numerous instances of Mycorhiza which are now known. As you are no doubt aware, many trees, shrubs and herbaceous plants are found to have their roots either invaded by or enveloped in fungus hyphæ, and we know that some of these Fungi belong to such genera as *Nectria*, *Elaphomyces*, *Polysaccum*, *Geaster*, *Agaricus*, *Lactarius*, *Cortinarius*, etc., though for the vast majority of them the fructifications—and therefore the systematic position—are quite unknown. We have also good grounds for believing that the fungus collects mineral salts and

nitrogenous materials from the vegetable mould, and hands some of these substances on to the plant in return for carbonaceous and perhaps other organic food-materials supplied by it. In any event, it is clear that the higher plant derives benefit from this symbiotic association in proportion to that enjoyed by the fungus, and in no case is this clearer than in that of the Orchids. Bernard has shown that the reason horticulturists have such difficulties in getting many orchid seeds to germinate is because the young seedling cannot develope unless its root is infested with the proper fungus immediately it emerges —a condition not always realisable. The same worker, as also Stahl, MacDougal and others, have also extended our knowledge of other forms of Mycorhiza of late, and the main facts are no longer in serious dispute among botanists. Green plants growing in humus have either to compete with the Fungi in the soil for the salts, especially potassium and phosphorus salts, which these Fungi are so well able to collect, or they have to compromise, as it were, with these Fungi and offer them something in return for such salts. That seems to be the *raison d'être* of Mycorhiza. I find it impossible to avoid asking whether these mysterious "ground" species are not struggling to obtain their nutriment from very different materials, and under very different conditions, and whether the circumstances of their varying nutrition do not affect them.

Obviously, the most satisfactory way of deciding these questions would be to do as we do in gardens with higher plants, viz., grow the alleged varieties and species side by side and record their behaviour. It happens, however, that just this method is peculiarly difficult of application to just these particular Fungi—the Hymenomycetes. Still, we are making a beginning, and already the labours of Van Tieghem, Brefeld, Costantin, Matruchot, Biffen and myself have led to results of importance, and shown that we shall gradually learn the conditions necessary for successful cultures, and I hope that my endeavours to extend these to parallel cultures may yet lead to success. At present, however, the difficulties have appeared almost unsurmountable, for reasons at which there is time only to glimpse just now.

If we ask what are the important features in the nutrition of those Hymenomycetes which grow on wood, dead leaves, and on humus, it must be admitted that very little is known. Several workers, myself among the number, have succeeded in cultivating various species of *Stereum, Pleurotus, Collybia*, etc., from spore to spore, and Brefeld especially has brought out a number of interesting facts concerning the morphology of such cultures with which, however, we are not here concerned.

Some of these cultures are relatively easy, as Biffen, working with *Collybia velutipes* in my laboratory, showed, and as my own experience with *Stereum hirsutum* demonstrated. With others, however, the reverse is the case. I will give you two instances. Last autumn I started pure cultures of *Marasmius androsaceus* and of *Mycæna vulgaris*, and from the ease with which the spores germinated, anticipated

no particular difficulty in getting the mycelium to go through all its stages to the formation of spores again. I transferred the young mycelia from the separation-plates to large flasks containing respectively, the leaves of grass, pine, beech, oak and fern, and the sawdust of pine and of oak, the intention being to compare the growth and characters on these media. No difficulty occurred in the early stages; the mycelium "ran" excellently, and all seemed going well up to Christmas-time. From then to now, however, although growth continues, no further development has been possible. As the failures are similar in all cases, I will confine my account to *Marasmius*, the more so since Brefeld and Costantin also failed with this genus.

I tried these cultures in the dark and in diffuse daylight, as well as fully exposed at a window. I tried them at high and low temperatures, even exposing some sets to winter frost. Some were kept moist, others allowed to dry up; some well aerated, others not. To some sets of cultures I added certain moulds—*Penicillium*, *Aspergillus*, or *Dematium*—in the hope that the quicker decomposition of the leaves set up by these Fungi would accelerate matters. All of no use, apparently! In almost every case—nearly 100 cultures were tried—the mycelium ran admirably, but when it had formed a well-developed white felt-work growth ceased, and nothing further came of the matter. There the white felt or spawn remains to this day. It is alive, but will not fructify.

Meanwhile I had also cultivated the mycelium—again successfully—on various gelatine and agar media, and obtained excellent strong growths on pith saturated with extract of decomposing pine leaves and a little xylose—a sugar obtained from wood—having frequently found such pith media very useful, and thinking xylose the most likely carbo-hydrate for such a fungus. Again no result. Even after ten months I had nothing more than a well-developed sterile mycelial felt. One result seemed clear, however, namely, the mycelium grows far better on vegetable media than on animal substances, such as gelatine with dung extract, which is not surprising when we remember the natural habitat of the fungus. It is generally assumed that the Fungi on dead leaves, wood, etc., utilise the humus of the forest soil as food-material, but Reinitzer has recently shown that purified humus is useless as a source of carbonaceous food even to *Penicillium* and *Aspergillus*, but that if such humus is added to a suitable carbo-hydrate, such as sugar, the former supplies nitrogen to the fungus, whence we may infer that my experiment with xylose was not without promise.

Do the failures mean that this *Marasmius*, apparently a most pronounced saprophyte on dead leaves, is really parasitic? Do its fine vegetative hyphæ after all play the part of a Mycorhiza, and only "run" on the dead leaves to throw up the pileus, the carbonaceous material for which has been stored up after collection from the roots of some tree? At present it seems impossible to say. But the failures of Brefeld, Costantin and myself to get this fungus to fructify on (in my experiments) the very media on which it is found in Nature are significant, and, although negative results prove nothing, warrant the questions I have raised.

In the culture of *Naematelia*, to which I draw attention elsewhere, the case is different in degree only; there also the conditions for perfect spores have not been attained.

It is evident that we are profoundly ignorant of the conditions of growth of the Hymenomycetes, and that much has to be done by all of us before we know even the relative value of the characters employed in the classification of the pileus and stipes on which so much depends.

Supposing by some imperial edict it was decided to classify all the people of a nation according to the colour of their eyes as a primary step, and to put all the black-eyed, brown-eyed, grey-eyed, pink-eyed and—well, I do not know of any white-eyed people—into totally different groups; then suppose we took all the black, brown, yellow, grey and white-haired specimens of each groups and put them together, and so on. It is clear that this would not lead us to a natural classification, and if the imperial edict compelled us to bury or embalm these people according to the same principles of grouping, we should have cemeteries very like our present herbaria in principle; and what I am fearing is that our herbaria are keeping permanently apart blood relations who ought to have been in the same graves, and whose tomb-stones ought to bear the same names.

Now, it must not be supposed that I am criticising the magnificent artificial scheme of classification of Fries in any iconoclastic or carping spirit; not only am I quite incapable of reforming it—and, moreover, am strongly of opinion that it should be upheld until a constructive genius of equal ability arises to reform it—but I give way to no one in my admiration of the astounding industry and grasp of details shown by that great expert, and by the workers who have followed out and further extended his monumental work, and our English handbooks by Berkeley, Cooke, Stevenson and Massee, as well as the—to me, at least—wonderful grip of the minute characters shown by several of my friends only confirm my astonishment at the beauties of this artificial system. Still we must not forget that Fries' system has dissatisfied many reformers as the emendations of Saccardo, Hennings, and others show. What I should like to promote is, however, a closer investigation into some of the points to see if we could not go further into these matters of species and of the causes which determine fructification, variation, etc. It is clear that something might be done by more accurate information respecting the habitats. As regards species on wood this should not be difficult, but we want to know more as to whether on living or dead wood, on Conifers or Dicotyledons, etc., on Pine, Fir, Oak, Elm, etc., and which species of each ?

As respects leaves, the matter is not so easy, but we want to know more as to whether on Pine, Beech, Fern, Grass, Moss, etc., and which species. Here difficulties occur as to whether the mycelium has merely crept on to the leaves to form its pileus, or really lives on or in the leaves—whether it is really a parasite, a mycorhiza form, or a saprophyte pure and simple.

Similarly with terricolous species, and those growing in pastures, where, however, the obstacles to accurate determination are greater still, but we have yet to learn that the existence of difficulties is a reason for avoiding a question to Nature ! It is important to know, not only whether the substratum is charcoal, burnt clay, sand, etc., but if the mycelium in open land runs into manure, humus, or even to the living roots of grasses, etc. Much has been accomplished, but more can be done by further observation in the field to direct the efforts of those who cultivate the forms with a view to settling these questions, and we must all admit that it is a branch of science that opens up splendid opportunities for research.

We should like to see more information regarding the shade-bearing, moisture-loving, wind-enduring and frost-resisting capacities of groups of critical and closely allied species, as well as statistics regarding season, altitude, habitat, etc., recorded with all the care and completeness possible. An excellent beginning has been made; why not carry it further ?

I must now conclude this series of jottings and questions, in which I fear little has been actually accomplished beyond exciting curiosity. But if I have succeeded in enlisting your co-operation in helping us to solve certain problems concerning the Hymenomycetes, much may yet come of it. Among the problems are :—What are the conditions which determine the sterility or otherwise of the mycelium ? How far are lignicolous or foliicolous forms able to adapt themselves to terricolous or coprophilous, etc., habitat ? What species are Mycorrhiza forms, or parasites, or facultative saprophytes ?

Is there any connection between the habitat and nutrition of the species, and their specific and generic character, *e.g.*, colour of spores, texture of pileus, hollow or stuffed stipes, adhesion, freedom etc. of lamellæ, or minor characters of colour, silkiness, etc., ? Can we find in the distribution of the species in latitude or altitude any explanation of the variation which it is admitted occurs within the limits of accepted species ?

The answers to these and a number of other general questions which might be undertaken in the field, would be very welcome to those of us who have to wrestle with the difficult problems which the culture of these organisms present.

ON THE BIOLOGY

OF A

NÆMATELIA Fr.

By H. MARSHALL WARD, Sc. D., F.R.S., &c.

During some investigations on the Hymenomycetes which grow on Pine-leaves made last Autumn, I found on the isolation-plates a yeast-like form the behaviour of which puzzled me exceedingly.

It grows readily on wort-gelatine, showing up in two days as circular plates of a pale yellow colour which soon spread, until in ten days to a fortnight each forms a slightly raised disc an inch or more in diameter, honey-yellow and marked with radiating vein-like ridges of a deeper orange or brick red colour, all spreading like wrinkles from a central spot of the same hue (Fig. 1). I have had such discs nearly $2\frac{1}{2}$ inches in diameter on the plates. Careful examination shows that these discoid growths are very glairy or gelatinous compact masses of mycelia, but in old cultures, when they dry up, they become exceedingly brittle and almost like horn. Immersed in the mass are two kinds of bodies, yeast-cells and what I shall term chlamydospores. Examination of the pale yellow young colonies, about the second day, shows that each consists of actively budding yeast-cells (Fig. 4) radiating from a common centre and forming a pasty mass which slightly softens or liquefies the gelatine. This mass is fringed by a number of short hyphæ radiating at the margins like a fringe of cilia. (Figs. 4, 6, 8 and 13). On the third day these radiating hyphæ have increased in number, as have also the yeast-cells from which they radiate, and here and there the hyphæ show swellings along their course. (Fig. 2). Each swelling is ovoid and soon fills with oily looking drops, and becomes segmented off from the rest of the hypha by a septum at each end, or, when terminal, below only.

As the colony grows, the central core of yeast-cells increases, and the number of radiating hyphæ and their swellings augment (Figs. 8 and 9), and the older, wrinkled discoid colonies (Fig. 1) consist of many hundreds or thousands of the latter radiating out from countless yeast-cells. The older more central oval bodies have by this time obtained thicker well-defined walls and are crammed with oil-drops, and are evidently of the nature of *chlamydospores* (Fig. 3), and will be termed so in what follows.

Obviously the first step was to determine beyond doubt that the

yeast-form and the chlamydospore-form belong to the same fungus, by the separation and culture of a single yeast-cell. This was done by isolating a single cell in a hanging-drop of the wort-gelatine and watching its development hour by hour in the usual way. The results were perfectly clear and absolutely conclusive on this point, as shown in figures 4—6 and Fig. 13, 14. The yeast-cell itself is long oblong or cylindric-ovoid (Fig. 4a), and varies in size from about 3 by 1 μ to 5 by 1·5 μ or even 6—7 by 2 μ, depending on the vigour and nutrition. It is extremely delicate, and when young and active is filled with hyaline protoplasm devoid of evident granules, oil-drops or vacuoles, though these may appear later, and under certain conditions the contents may be very oily (Fig. 12).

It is quite easy to obtain the yeast-cells in pure culture, since they are at once washed out of their slimy matrix in water and can be isolated in the ordinary way.

Thus sown in wort-gelatine at ordinary temperatures, the cell buds at one end in a few hours (Figs. 4—6), and repeats the process usually at the other pole soon afterwards; each daughter-cell may then again repeat the process, and new buds arise from the parent, and so on until a small colony results. (Fig. 3 *a. b.*) It depends upon the food material, temperature and other conditions how long this budding process continues, as well as how rapid the formation and separation, etc., of the cells are. Thus in wort-gelatine at ordinary temperatures it may require three hours and less to complete a bud, whereas on a poor food-medium, or if the temperature is high—22°C and over—it may take a day or more. Compare Figs. 4—6 with Fig. 7. I may add that it is frequently the case that fungus cultures are attempted at too high a temperature, and abnormal results are obtained; it is by no means certain that in the present instance I have succeeded in obtaining the optimum temperatures, but growth goes on very well at those given.

In the course of 24 to 36 hours or so, when a small colony of yeast-cells has been formed, some of the marginal cells change their mode of growth and the buds no longer separate but elongate into radiating hyphæ—Fig. 4 *e*, Fig. 5 *e*, Fig. 6 *d*, and Fig. 6*a*. It is these hyphæ which, rapidly increasing, form the halo-like fringe around the colony (Figs. 13 and 14). Each hypha is about 1-1·5 μ in diameter, sinuous and septate, and soon branches below the septa (Fig. 14). As soon as the halo of hyphæ is well developed—*i.e.*, about the third day in good cultures—the older of them begin to form chlamydospores, by dilating at the tips into pyriform or ovoid swellings full of translucent protoplasm, in which minute oil-drops rapidly form, enlarge, and run together (Fig. 15). Very often the apex is prolonged into a short beak (Fig. 15), which may grow on and repeat the process (Fig. 2), but in other cases the terminal swelling remains rounded at the tip (Fig. 2). Every transition may be found between terminal rounded or globoid chlamydospores, with or without the beak, and intercalary ones, often in series (Figs. 2 and 3). As they get older the wall thickens and the oily-drops become more evident, often presenting a curiously striking resemblance to spores in a sporangium (Figs. 3 and

10). The ordinary reactions—solubility in alcohol, blackening in osmic acid, staining with alkanet, etc.—show beyond doubt their oily character. They vary in size from spheroids, 7-8 to 10-12 μ in diameter, to ovoids, 14-15 by 10-12 μ

It was thus established, by direct observation in hanging-drop cultures, that the yeast gives rise to the hyphæ which swell into the chlamydospores, every stage in the development of which was followed.

Attempts were then made to get the chlamydospores to germinate, but although it was possible to isolate them in hanging drops in spite of the difficulty of separating all yeast-cells—which gave trouble by growing first and over-crowding the chlamydospores—I found no trace of germination of the latter in the first state. Nor was any success obtained after heating the wort-gelatine containing the spores to 55°C for five minutes. This killed the yeast-cells, and I was able to keep chlamydospores under observation in hanging drops, but in no case was I able to obtain the slightest direct evidence of their germination. Of course they may have been killed also, though it does not appear likely.

In one or two plates of the mixed yeast and chlamydospores in wort-gelatine heated as above, a few straggling colonies did appear after a fortnight, suggesting that one or two yeast-cells may have survived the heating to 55°C.

Many other attempts were made to get the chlamydospores to germinate. Not only were they sown fresh, but also after drying, after freezing, and, as we have seen, after heating. Digestion in gastric juice was equally of no avail.

Of the media tried, in addition to wort-gelatine, I employed wort-gelatine with extract of cow-dung added; wort-agar, agar with extract of horse-dung; agar with decoction of willow-wood, with extract of rotting pine-leaves, the same with Levulose added, gelatine with beech-wood extract, etc. Also the dead leaves of pine, beech, oak, grass, fern; the saw-dust of oak and of pine; blocks of beech-wood and pine and of rotten willow, as well as the same saturated with extract of willow. Pieces of mushroom were also used. Elder-pith, saturated with Klebs' solution, or with extract of pine-water with or without xylose, in all cases without success. Nor would the chlamydospores germinate in any of the following carbo-hydrates, made up in 10 °/o solutions with yeast extract.

Saccharose, dextrose, lactose, mannite, maltose, xylose, dextrine, gum, all of which were tried at 32°C, 24°C, and at ordinary temperatures, 16-18°C, as were the other more solid media. It may therefore be concluded that either these chlamydospores require some very special conditions to force them to germinate, or they are incapable of further growth—a very unlikely view.

The yeast-form, on the other hand, grows readily on all the above media except the following: Beech-wood gelatine, elder-pith with Klebs' solution, rotten willow blocks with or without willow extract, mushroom, and the dead leaves and sawdust, on which it either refuses to grow at all or buds very sparely.

It developes most rapidly on wort-gelatine, as described, but the growth is also good on sterilised blocks of pine, where it rapidly invades the cortex and cambium, and forms the typical wrinkled thallus, but with a pinkish-orange or flesh-coloured hue reminding one of a *Tremella*, and abounding in chlamydospores of the normal form and arrangement. As the growths aged they turned pink-brown.

It also grows well on wort-agar, on agar with pine extract and Levulose, and on wort-gelatine with extract of cow-dung. The development is distinctly inferior on agar with horse-dung, or with willow extract, and on pith saturated with pine-water. This is suggestive seeing that it grows very well on agar with pine-water and Levulose, and should be compared with the behaviour on agar with horse-dung and wort-gelatine with cow-dung. Clearly the presence of wort or a sugar such as levulose promotes the growth, whereas dung extracts obstruct it. This points to its being a fungus which developes on vegetable matter and not on dung or animal substances, and is quite in accordance with its origin from pine leaves. On the carbo-hydrates made up with yeast extract, mentioned above, the behaviour was as follows.

The best growths were with dextrose, the next best with gum, and mere traces of development occurred in dextrine, lactose, xylose, mannite, maltose, or even saccharose.

The effects of temperature came out very clearly in these cultures, and I verified them in cultures on agar media and in hanging drops. At 32°C no growth at all occurred; at 22°C it was very slow and appeared not to take place above 24°C; at 16-18°C it was much better and apparently most rapid.

No signs of fermentation were to be observed in any carbo-hydrate, and since levulose and dextrose appear to suit the fungus best we may conclude that the yeast cannot invert saccharose, maltose, lactose or xylose.

Although I have had the fungus in culture for a year, no further development has occurred on any of the media under any conditions tried, and we must conclude that it is able to go on repeating its development in the form described for indefinite periods. Whether it actually does this in the forest cannot be decided, but it is obvious that it may do so.

Nevertheless I shall give reasons for believing that such would probably not occur, but that in Nature some conditions are realised—which I have failed to imitate—which would impel the chlamydospores to grow out, or germinate and complete the development of what is here an arrested form. Moreover, I think there are very good reasons for expecting that the completed form would be a *Tremella*, and that in its present arrested condition it would go into *Naematelia*.

Before doing this it is interesting to observe that the flat, yellow, wrinkled, and apparently full-grown discoid growths shown in Fig. 1 were sent to several mycologists with the request that they would give me their opinion as to the identification of the fungus. This they were kind enough to do, and I take this opportunity of thanking them. All were very guarded in their replies, at which no one can wonder,

seeing that I merely sent the thallus, in formalin or spirit, with no information as to its source, but the following genera were suggested as those to which the fungus might belong :—*Phlebia*, *Michenera*, * *Tremella*, *Nœmatelia* and *Aegerita*.

Aegerita is an old genus, established by Persoon,† and evidently refers to some imperfect form. It agrees in some respects with the present form, and especially in the size of the "spores," but the descriptions are too vague for decision. It would possibly be worth while to keep this genus of *Fungi imperfecti* in mind, however, for comparison of, say *Aegerita virens* (Carm.) with *Nœmatelia virescens* (Corda) and *Tremella atrovirens* (Fr.) in culture, and in the light of what follows.

On looking at the other four genera suggested, one is struck by the fact that they are all Basidiomycetes, *Phlebia* being the highest, *Michenera*, generally put near *Corticium*, coming next, while *Tremella* follows with *Naematelia* close in its neighbourhood and probably merely an arrested form of it. *Phlebia*, I think, we must reject. I can find no trace of the pectinate ridges, or of the oidia which Brefeld has shown to be characteristic of the species he cultivated. At the same time there are some points of resemblance in the texture, and we still require information as to this genus. It would appear from Berkeley and Curtis' description‡ that the present fungus is not *Michenera* (B & C)—*Artocreas* (B &C).‖ Not only is the hymenium of the latter quite different, but the spores are twice the size, and there is no mention of the gelatinous consistency, wrinkled surface, etc. We may therefore conclude that this tropical genus is still unrepresented in Europe.

Patouillard (*Remarques sur l'organisation de quelques champignons exotiques*). Bull de la Soc. Mycol. de Fr. T., vii., 1891, p. 42) examined *Michenera artocreas* (Berk and Curt) from Cuba and N. America, and decided that it should be removed from the Thelephoreæ, and even from the Basidiomycetes, and regards it as a particular type of Uredineæ, comparing it to *Uromyces*, etc. He makes no mention of any yeast-form, and bases his opinion entirely on the adult structure. In the absence of more convincing evidence we must reject this view.

Brefeld§ remarks that the genus *Naematelia* (Fr.) must be merged in *Tremella* since it was distinguished only by its rounded basidia, a character he claims for the true *Tremella*. He also remarks that *Naematelia* forms yeast-conidia, and that Fries had already made the observation that basidia had been mistaken for spores in this genus. Fries' words are "*sporophoris pro sporis sumtis*." ¶

* I owe to the courtesy of Mr. Massee the suggestion that the fungus might possibly be a *Michenera* rather than a *Naematelia*.

† Persoon Disp. Fung. p. 40.
‡ Journ. Linn. Soc. Vol. x. 1869, p. 333.
‖ „ „ „ „ xv. 1877, p. 83.
§ *Untersuchungen*, &c. H, VII. 188°, p. 107.
¶ Hymenomycetes Europ. 1874 p. 696.

It is also interesting to note that Tulasne had thrown doubts on the existence of the genus *Naematelia**, pointing out that the immature globoid basidia of *Tremella mesenterica* had been mistaken for spores, and if we look at Tulasne's figure 4, plate 11, the vertical section of a young *Exidia* there depicted shows very clearly how such a mistake might be made, and exhibits astonishing resemblances to the form I have described.

If we examine Brefeld† and Moeller's‡ results of the cultivation of *Tremella*, very suggestive ideas as to the significance of the yeast-form are to be obtained, for Brefeld found that all the species of *Tremella* have these secondary organs of propagation.

If we now turn to Brefeld's figures‖ of the "yeast-conidia" of *Tremella*, it must be confessed that the much more rounded forms are different from those I have obtained in my cultures; nor do the sizes agree, a point probably of less importance since, as we have seen, the dimensions vary considerably. On the other hand, the characters of the colonies—*e.g.*, Pl. viii., Fig. 16—are in some cases strikingly similar, and the growing out into hyphæ, radiating from the colony, is quite similar—c.f. Brefeld's Figs. 16. 2 and my Figs. 5 *e* and 6 *e*—a point of no small significance in my opinion.

If this view is correct, we have the interesting fact that the basidia of a fungus such as *Tremella* may become arrested, their protoplasm filled with stores of oil, and their walls thickened in the manner characteristic of chlamydospores. The fact remains, however, that I have never succeeded in getting these chlamydospores to germinate.

* Ann. des. Sc. Nat. 1853 Ser. iii. T. 19 p.p. 203–4.
† Brefeld *Unters.* H. VII. 1888, p. 106.
‡ Moeller *Protobasidiomycetes* 1995, p. 99,
‖ Unters. H. VII. 1888, pl. vii. and viii.

DESCRIPTION OF FIGURES.

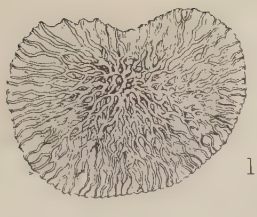
Fig. 1. An old colony on wort-gelatine.* Nat. size. In colour it was deep orange yellow.

Fig. 2. Part of the extreme margin of the same, showing the chlamydospores and a few yeast-cells immersed in mucilage × about 400.

Fig. 3. Thoroughly ripe chlamydospores from the older parts of the colony, showing the oily contents and firm cell-walls × about 1,000.

Fig. 3. (*a*) A chlamydospore and two yeast-cells isolated in wort-gelatine in a hanging-drop at 12 noon on Dec. 14; (*b*) the colonies resulting from the growth of the yeast at 11.15 on Dec. 15. The chlamydospore showed no signs of germination then or later. × about 800.

* This drawing was kindly made by Miss Dawson D.Sc. The others are by the author.



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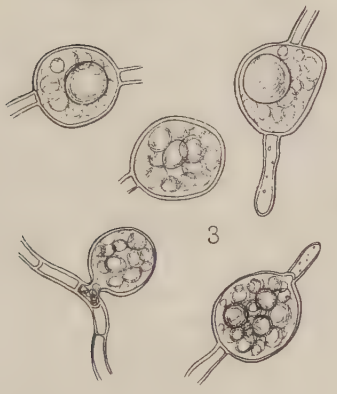

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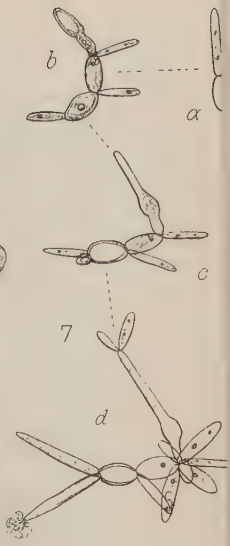

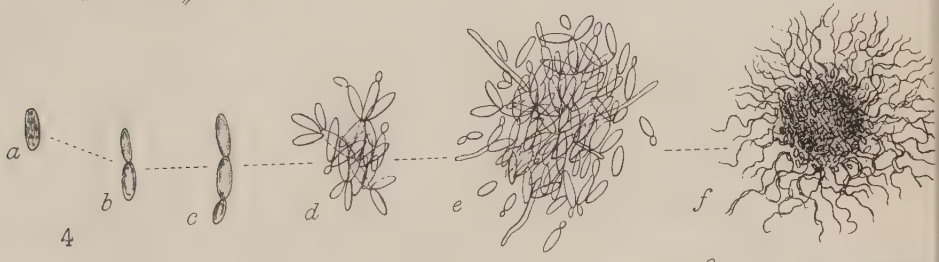

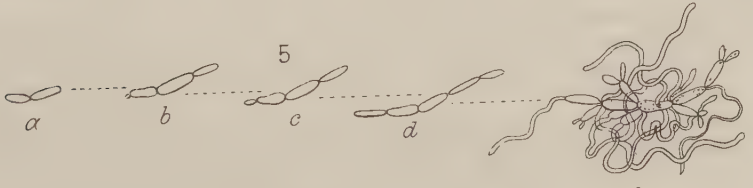

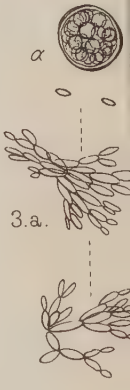

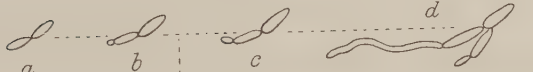

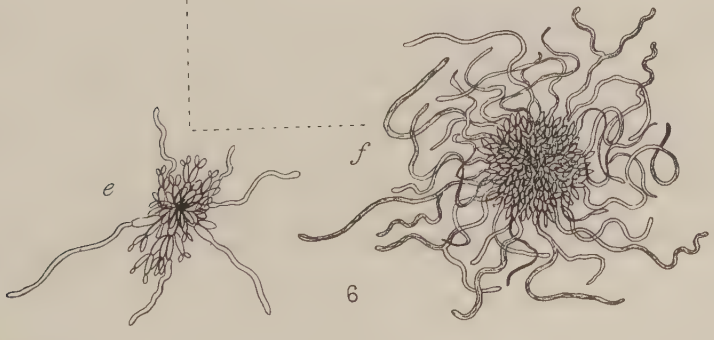

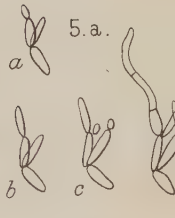

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Fig. 4. A single yeast-cell isolated in a hanging-drop of wort-gelatine was fixed (*a*) at 12 noon; at 9 p.m. it had budded off another cell (*b*); at 12 p.m. (*c*) a second bud had formed at the opposite pole. Next morning at 9.30 a rapidly growing colony was formed (*d*), which at 2 p.m. (*e*) showed signs of outgrowing hyphæ. At 10 a.m. on the day following the much larger mass of budding yeast-cells was surrounded by a fringe of wavy hyphæ, t. 18°C falling to 14-15° during the night. *a-e* × about 800; *f* × about 30.

Fig. 5. A similar series, *a* at 12.20, *b* at 3 p.m., *c* at 3.30, and *d* at 8.20 p.m. At 10 a.m. next day the colony (*e*) was putting out hyphæ, clearly traceable to the yeast-cells. Culture in wort-gelatine at ordinary temperatures, as before. × about 800.

Fig. 6. A similar series, showing still more clearly that the hyphæ spring from the yeast-cells; *a* at 12.30, *b* at 3.10 p.m., *c* at 3.40, and *d* at 8.30 p.m.; *e* at 9 a.m. next day, *f* at 4 p.m. Medium, temperatures and magnification as before.

Fig. 7. A similar culture, in wort-gelatine as before, but at a higher temperature—22-23°C. The yeast-cell was isolated at 12 noon on Dec. 14, and at 11.15 a.m. on Dec. 15 had only developed as in *a*; *b* shows its condition at 11.30 a.m. on Dec. 16, and since it had only grown to the stage shown at *c* by 2.45, and remained stationary at 4.5 p.m., the temperature was reduced to 17.5-17°C. At 11.30 next morning (Dec. 17) it was recovering its activity (*d*) and thence grew as rapidly as the specimens shown in Figs. 4-6. Magnification as before.

Fig. 8. A colony on wort-gelatine at ordinary temperatures on the fifth day. It is still actively growing, and has only just begun to form chlamydospores in the central older portions × about 30.

Fig. 9. A colony the same age on wort-gelatine and extract of cow-dung. It has already finished its growth and has numerous ripe chlamydospores all over × about 30.

Fig. 10. A group of ripe chlamydospores from the last culture × about 800.

Fig. 11. Irregular growth and imperfect chlamydospores forming at 24°C × about 400.

Fig. 12. Extremely fatty contents of chlamydospores and yeast-cells from a three weeks' culture on pith with pine extract and xylose. The growth was poor, and many irregular imperfect chlamydospores are forming. × about 800.

Fig. 13. A colony 3 days' old in dilute wort-gelatine at 16°C from a yeast-cell which had been exposed outside and repeatedly frozen (on wort-agar from Dec. 29 to March 2). The growth was rapid and strong, and numerous chlamydospores were already formed on the older parts. × about 50.

Fig. 14. Part of the margin of the same colony, showing the mode of

growth and development of the chlamydospores. × about 1,000.

Fig. 15. Successive stages in the development of a chlamydospore at the margin of the same colony; *a* at 11.50, *b* at 3.30, *c* at 5.10, and *d* at 8 p.m. × about 1,000.

Fig. 16. Transverse section across a colony such as Fig. 1, showing the ridges covered with chlamydospores and yeasts embedded in a gelatinous mass, and the hyphæ below similarly gelatinous. Hardened in Keiser's fluid and stained with Haematoxylin × about 80.

Fig. 17. Part of the lower portion of the mycelium of last preparation × about 400, showing hyphæ embedded in gelatinous matrix.

Fig. 18. Part of a ridge of Fig. 16 showing chlamydospores and their hyphæ embedded in jelly. × about 400.

FUNGI NEW TO BRITAIN.

By Annie Lorrain Smith.

Entomophthora Pooreana A. L. Sm. Journ. Roy. Micros. Soc. 1900, p. 442, pl. iii., fig. 1.

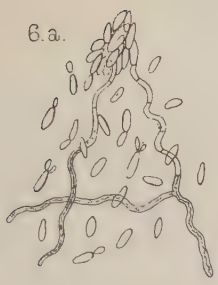
Hyphæ abundant, interwoven, breaking up into short lengths, varying in width from 5 μ upwards, septate; resting spores formed in an intercalary manner on anastomosing hyphae, globose, varying from 25 μ to 40 μ in diameter, with a thick yellowish epispore and granular contents.

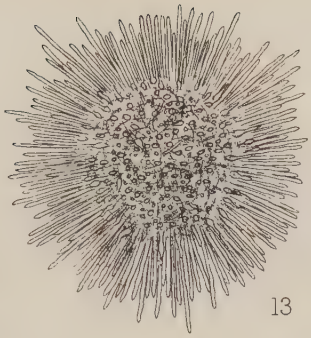
Found in the tissue of a rabbit that had been buried in a garden at Isleworth, about 3in. beneath the surface of the soil, until almost disintegrated.

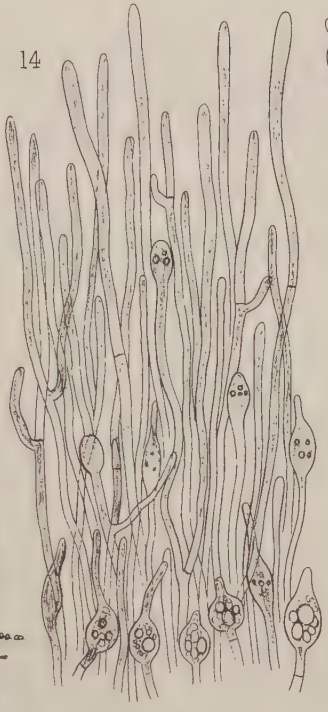
Oospora coccinea Sacc. and Vogl. Syll. Fung. Vol. IV., p. 21.

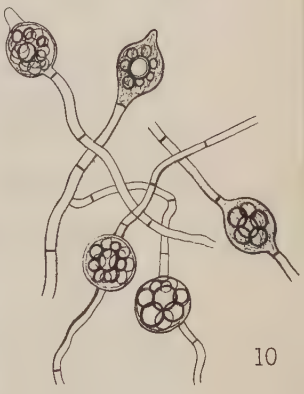
Tufts minute, separate or confluent, brick-red to vermillion, fertile hyphæ erect or spreading, lax or intricately compact in the mass, sparingly and irregularly branched, straight or slightly wavy, paler than the conidia, 100-140 μ long by 4-6 μ thick below, thicker and somewhat moniliform above, preparatory to the formation of conidia; conidia plentiful, globose, 11 μ to 18 μ in diameter, brick-red, in simple or branched chains.

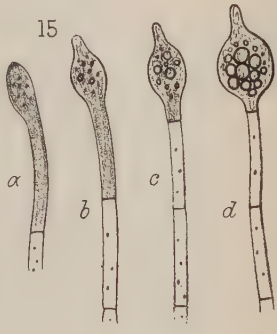
On cat's dung, Halifax, 22nd February, 1899. Naturalist, Jan. 1900, p. 8.

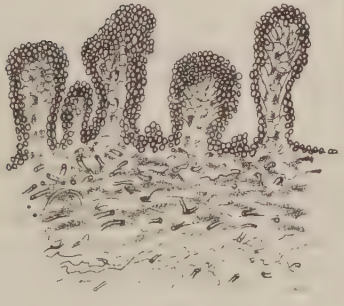


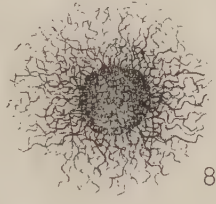


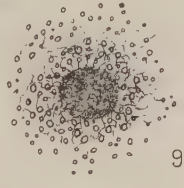


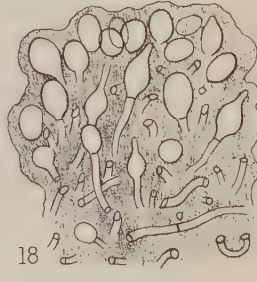












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Œdocephalum glomerulosum Sacc. Syll. Fung. Vol. IV., p. 47.

Tufts gregarious, rose-coloured; fertile hyphae ¼ mm. long, septate, cylindrical, slightly attenuated upwards, the apex terminating in a verrucose vesicle; conidia large, ovate 25 × 12 μ, pallid rose-coloured, with an apiculate base, forming a subsphaerical head.

Growing on *Tubercularia* and *Sclerotia* on branches of trees. Found in Mulgrave Woods, Yorkshire, September 1900. Mr. C. Crossland.

Botrytis dichotoma Corda. Ic. Fung. I., p. 18, fig. 244.

Tufts minute, fugacious, whitish cinnamon coloured; fertile hyphae erect, dichotomous, spreading, terminal branches, obtuse slightly curved inwards, colourless; spores numerous spherical, cinnamon-yellow.

Found by Mr. Greenwood Pim on a decaying stem in his garden, Co. Dublin. Irish Nat., p. 98, 1900.

It is to be regretted that Mr. Greenwood Pim did not complete the defective description of this interesting fungus.

Fusicladium pyrinum Fckl. Symb. Myc., p. 357.

Forming effused, velvety, rusty-brown spots; mycelium spreading just under the cuticle, finally penetrating and blackening the tissue; conidiophores upright, short, nodulose, irregular in form, denticulate at the tips, usually about 20 μ in height; conidia ovate-fusiform, 15-30 μ by about 7 μ, one-celled, brownish-yellow, smooth, solitary, or two or more on the same conidiophore.

Parasitic on the leaves and fruit of *Pyrus communis*, Worcester and Hereford. June 1900. Journal of the Royal Microscopical Society, 1900, p. 424.

Helminthosporium gramineum Rabenh. Herb. Myc. 332.

Forming elongate pallid spots with a brown edge, fertile hyphae solitary or in clusters, erect, often angularly bent, brown; conidia yellowish-brown, straight, cylindrical, 1-5 septate, 50-100 × 14-20 μ.

On leaves of barley, from Hertfordshire.

Aleuria albida Gillet. Discom. p. 36, with plate.

Ascophores 2-3 cm. diam., disc concave, stem short, even, margin spreading, fleshy-cartilaginous (not fragile), pale wax yellow, exterior albo-furfuraceous of little heaps of loose, sub-globose, thick-walled detached cells; asci cylindrical, apex sub-truncate 200-220 × 9-10 μ, spores occupying less than half the space when mature, obliquely uniseriate, elliptic, hyaline, smooth, 10-12 × 7-8 μ; paraphyses linear, or apex slightly swollen, septate, longer than the asci.

Warehouse yard, Halifax, June 1895, and Sept. 1896. Collected by Mr. H. T. Soppitt. Mr. Crossland. Naturalist, Jan. 1900, p. 7.

Barlaea Persoonii Sacc. Syll. Fung. VIII., p. 117.

Ascophore sessile on a narrow base, hemispherical then expanded, disc plane or undulate, 4-8 mm. across, wholly pale-dingy amethyst, glabrous, margin rather obtuse, flesh waxy-brittle 1·5-2 mm. thick; excipulum parenchymatous, cells globose or elongated 35-60 μ (longest diameter), hyaline, cortex thin of not more than 1-2 layers of globose cells 20 μ in diameter; hypothecial cells small and almost indistinguishable in outline; asci cylindrical, 200-210 × 13-14 μ, apex rounded, pedicel narrow; spores eight, uniseriate, hyaline, spherical, rough, 1-2 guttulate, 9·5-11 μ in diameter; paraphyses cylindrical, simple or branched, septate, hyaline, 3-4 μ thick, apex always curved.

Hebden Bridge, July 1899, Mr. Needham. Mr. C. Crossland in Naturalist, January, 1900, p. 9.

Mollisia betulicola Rabenh. Krypt. Flora I., part 3, p. 538.

Apothecia small about $\frac{1}{2}$ mm. across, gregarious on whitened spots, sessile, at first closed, globose, then open, and disclosing the pale-reddish or yellowish disc; the exterior black, scabrid or substriate, the margin slightly lacerate; asci oblong or clavate, acuminate at the tips, attenuated downwards to the stalk 56 × 8 μ, 8-spored; spores obliquely 2-seriate, oblong, obtuse at both ends, colourless, guttulate, 8-10 × 3 μ.

On decaying birch leaves, Hebden Bridge, Yorkshire, June 1899. Collected by Mr. J. Needham. Naturalist, Jan. 1900, p. 7.

Dasyscypha Richonii Mass. = *Trichopeziza Richonii* Sacc. Syll. Fung. Vol. VIII., p. 415.

Ascophores minute, ·2-·5 mm. wide, gregarious, entirely red, hairy, sessile, fleshy, cup-shaped, the exterior and chiefly the margin covered with pointed septate hairs 50-120 μ long, 3-5 μ thick at the base, thinner at the apex; paraphyses delicate, filiform, sparsely septate, not thickened at the tips, colourless about 2 μ thick; asci broadly clavate, 8-spored 40-45 × 9 μ; spores minute elliptical-fusiform, biguttulate 5-7 × 2-2·5 μ.

On rotten wood. Found in Mulgrave Woods, Yorkshire, Sept. 1900. Mr. Gibbs. Naturalist, Nov. 1900, p. 341.

Belonium Sacc. Consp. gen. Disc., p. 7, 1884.

Apothecia sessile or shortly stalked, waxy-leathery, saucer-shaped, when dry rolled inwards and closed, black or brown, smooth or somewhat downy, the margin often with short black projecting hyphae; asci elongate 8-spored; spores elongate-fusiform or elliptical, 2-many-septate, colourless; paraphyses thread-like.

B. pilosum Crossl. Naturalist, Jan. 1900, p. 6, pl. 10, figs. 7-13.

Apothecia scattered, gregarious or crowded, sessile, subglobose, becoming plane, margin raised, whitish, 1-1·5 mm., rarely 2 mm. broad, the margin and exterior pilose-papillose, silvery-grey above, brown at the base; disc blackish-grey; hairs clavate, 1-2 septate, 25-30 × 8-10 μ, pallid brown with a colourless apex; hypothecium of delicate filaments radiating from the base to the margin, excipulum composed of subglobose cells, 7-9 μ in diam.; asci cylindrical-clavate, with a narrow round thickened apex, that stains with iodine, 8-spored, 70-80 × 8 μ, spores 2-seriate above, 1-seriate below, fusiform or cylindrical-fusiform, straight or slightly curved, 3 septate, 18-24 × 2-5 μ; paraphyses cylindrical, 3·3-5 μ thick.

On one year old stems and leaves of *Carex pendula*. Elland, near Halifax, May 1890.

Ascobolus stictoideus Speg. Mich. I., p. 474.

Ascophores loosely gregarious or scattered, immersed, minute, with a torn slightly projecting margin scarcely $\frac{1}{2}$ mm. across, externally watery-white, the disc pallid-olivaceous, punctuated by the projecting asci; asci few, 5 to 10 in number, 150-160 × 40 μ clavate-saccate, shortly and thickly stalked, with a thick membrane at the apex, 8-spored; paraphyses septate, curved at the apex; spores bi-seriate or irregularly uniseriate; elliptical, 25 × 14 μ, at first colourless, smooth, then violet, minutely and densely verruculose, becoming brownish rose-coloured.

On dog's dung. Halifax, Feb. 1899. Coll. Mr. H. T. Soppitt. Naturalist, Jan. 1900, p. 8.

Ascobolus minutus Boud. Bull. Soc. Myc. IV., p. XLVIII., t. II., f. 1. Naturalist, Jan. 1900, p. 8.

Gregarious or scattered, minute, 0·5-0·7 mm. across, brown, obconical or hemispherical, then lenticular, exterior smooth, tawny, disc plane or convex, asci slightly projecting, forming black papillae; paraphyses septate, subclavate at the apex, 5-7 μ across; asci minute 8-spored, 140-170 × 13-14 μ; spores minute, elliptical, violet then dark brown, longitudinally striate, the lines scarcely anastomosing 13-15 × 7-9 μ.

On dog's dung. Hebden Bridge, July 1899, Mr. Needham.

The asci being comparatively slender the spores remain uniseriate until ejected.

Gymnoascus ruber van Tiegh. in Bull de la Soc. bot. de France, Vol. 24, 1877.

Clusters cushion-shaped, the colour of red sealing wax mostly coalescing and forming a continuous layer; hyphae irregularly branched, much entangled, with rather delicate walls; asci spherical

10-12 μ in diameter, 8-spored ; spores globose-orbicular 4·5-5·5 μ in diameter ; conidiophores rising both from the asci-bearing and enveloping hyphae, bearing above verticillate branches with chains of loosely-attached oval conidia at the tips.

On dog's dung. Llanymawddwy, N. Wales, Sept. 1900.

G. verticillatus A. L. Sm. Journ. Roy. Micros. Soc. 1900, p. 423, pl. iii., fig. 2.

Fruit composed of loose, deep-brown hyphae, the outer ends free, thick walled, with regular verticils of 4 curved blunt branchlets up to 15 μ in length and about 5 μ in width, the inner ends narrower, irregularly branched, the branches somewhat angular, the whole forming tangled clumps ; ascus-like groups of spores somewhat oblong 10 $\mu \times 7$ μ, dark-coloured; spores minute, globose, about 2·5 μ in diameter.

On the bones of a dead rabbit that had been buried under a tree, in a garden at Isleworth, for about a year. The asci were evidently quickly evanescent, but many groups of 8 spores closely compacted were scattered about.

Thielavia Zopf. in Sitzungsber d. Botan. Ver. d. Prov. Brandenbg., June, 1876, p. 105.

Perithecia globose, without appendages and without an ostiole ; asci 8-spored, short and broad, evanescent, no paraphyses ; spores brown, one-celled ; conidia formed terminally in chains and also endogenously in the hyphae.

Thielavia Soppittii Crossl. Naturalist, Jan. 1900, p. 7, pl. 10, figs. 4-6.

Perithecia scattered or sub-gregarious, superficial without a stoma, subglobose, red-brown, fragile, membranaceous 250 μ in height ; asci elliptical or ovate, evanescent, 56-60 $\times$ 35 μ ; spores somewhat elliptical unequal-sided ; epispore thick, hyaline yellow, then opaque-brown, granular within, 28-30 $\times$ 16 μ.

Near the base of decaying stems of *Carduus palustris*. Norland, near Halifax. Coll. Mr. H. T. Soppitt, Nov. 1899.

Sphaerotheca Mors-uvae Berk. & Curt. in Grev. IV., p. 158.

Mycelium dense, rather thick, forming spots on the leaf with a white margin, dusky-brown at the centre ; perithecia minute, numerous, scattered, black, globose-applanate, wrinkled, at length emerging from the mycelium ; spores 15 μ long.

On leaves and berries of gooseberry. Ireland. Mr. E. Salmon.

Hypocopra Serignanesis H. Fab. Sphaer. Vaucl., p. 77.

Perithecia scattered, superficial, black, cylindrical-conical, wrinkled

1 mm. high and ½ mm. across, the apex somewhat depressed, pierced by a small pore; asci cylindrical 4-spored, long-stalked 250-300 μ long; paraphyses filiform numerous, often forked; spores elongate-fusiform or elliptical, one-celled, colourless, 9-12 μ × 3 μ.

On rabbit's dung. Hebden Bridge, Yorkshire, July 1899. Coll. Mr. J. Needham. Naturalist, Jan. 1900, p. 8.

Coniothyrium Boydeanum A. L. Sm. Journ. Roy. Micros. Soc. 1900, p. 423, pl. 3, fig 3.

Perithecia in small groups or scattered, developed on the inner bark and bursting the cuticle, somewhat lentiform 300 μ × 200 μ, parenchymatous, surrounded by a few loose hyphae, yellow-brown; spores globose-ovate, usually about 12 μ in diameter, but varying to 15 μ × 10 μ, colourless, then dark smoky-brown, smooth, with granular contents.

On dead branches of *Fuchsia*, collected at Sea Mill, Ayrshire, by Mr. D. A. Boyd, Oct. 1899.

Libertella blepharis A. L. Sm. loc. cit., pl. iii., fig. 4.

Pustules of one or several cavities beneath the outer bark, the spores escaping by a wide opening, and forming a milk-white layer on the surrounding bark; sporophores erect, slender, branched, slightly stouter and of denser contents than the spores; spores filiform, curved, sometimes strongly falcate 25-40 μ × 1·5 μ.

On dead branches of *Prunus cerasus* and *Pyrus malus*. Ayrshire, Oct. 1899. Mr. D. A. Boyd.

L. corticola A. L. Sm. loc. sit., p. 424, pl. iii., fig. 5.

Pustules forming effused whitish spots under the outer bark, the spores escaping and forming a milk-white layer; spores straight or slightly bent, colourless 20-25 μ × 1·5 μ, borne on closely packed sporophores that line the irregular infolding tissue of the pustule.

On dead branches of *Pyrus communis*. Ayrshire, Sept. 1899. Mr. D. A. Boyd.

L. Ribis A. L. Sm. loc. cit., pl. iii. fig. 6.

Forming lentiform, effused pustules under the outer bark, bursting the cuticle and the spores oozing out in a gelatinous pinkish mass; spores much curved, sometimes forming a complete semi-circle, 30-40 μ × 1 μ, colourless.

On branches of *Ribes rubrum*. Ayrshire, Oct. 1899. Mr. D. A. Boyd.

L. Salicis A. L. Sm. loc. cit., pl. iii., fig. 7.

Pustules formed in the cortex, convex or triangular in section,

causing slightly elevated reddish-coloured spots on the bark; spores curved, 25-35 $\mu \times 1{\cdot}5\ \mu$, colourless.

On dead branches of *Salix cinerea*. Ayrshire, Autumn 1896. Mr. D. A. Boyd.

Colletotrichum Corda.

Pustules innate-erumpent, applanate, disciform or elongate, black, surrounded by black setae; spores fusiform, continuous, colourless, on short fasciculate sporophores.

C. Lycopersici Chester.

Growing on depressed, circular spots, which afterwards become irregular and confluent; pustules abundant, densely gregarious, rusty-brown to black, applanate, 95-150 μ in diameter; setae abundant, dark-brown, generally curved, rarely undulate or straight, often geniculate in places, gradually tapering, septate 65-112 μ long, about 5 μ thick at base; spores oblong, ends sub-acute 18-20 $\times$ 4 μ on short, slender sporophores arising from a well-developed stroma.

On fruit of cultivated tomato. Found on potato haulms in a field near Worcester, Aug. 1900. Also in a garden, Lythe, Yorkshire, Sept. 1900. The diseased stems are blackened as if scorched. Mr. Crossland in Naturalist, Nov. 1900.

Lactarius glaucescens Crossl. Naturalist, Jan. 1900, p. 5, pl. 10, figs. 1-3.

Milk acrid, copious, white, at length glaucous-green; pileus fleshy, rigid, 4-6 cm. broad, convex, umbilicate-depressed, smooth, dry, not zoned, whitish or cream-coloured with small yellowish spots, margin involute, without striae; flesh white, compact, about 8 mm. thick, 2 mm. thick at the margin; gills adnate, crowded, sometimes furcate, narrow, 1·5 mm. broad, the same colour as the pileus; stalk 2·5-3 cm. long and 1·25 cm. thick, solid, widening upwards, smooth, the same colour as the pileus; spores colourless, globose, minutely echinulate, 6-7 μ in diameter; cystidia cylindrical or subclavate, with granular contents, 50-60 $\times$ 7-8 μ.

Wade Wood, Luddenden-dean, near Halifax, Aug. 1899. Mr. James Needham.

Crepidotus putrigenus Berk. & Curt. Ann. & Mag. of Nat. Hist., Ser. 3, Vol. IV., p. 292, 1859.

Imbricate; pileus subreniform, 12-19 mm. broad, whitish, tomentose, beset at the base with a delicate white tomentum; gills broad, whitish, becoming ferruginous-brown; spores subglobose, 7 μ in length, ferruginous.

On damp wood. Found in Mulgrave Woods, Yorkshire, growing from the sides and sawn end of a log almost buried in bracken. Sept. 1900.

*Collybia retigera** Bres. Fung. Trid., p. 8, pl. iv. (1881).

Pileus fleshy, thin campanulate, then expanded, more or less umbonate, dry, glabrous, pallid, centre with a tinge of tawny brown, 3-6 cm. across, margin striatulate, surface of pileus with a more or less developed network of anastomosing veins, especially when old ; gills rather broad and ventricose, pallid, margin fimbriate, stem almost equal, pallid, minutely downy at the base, solid or stuffed, 4-7 cm. long, spores elliptical 5-6 × 7 μ.

Roots of ash tree, S. Austria.

The net work on the pileus becomes more visible after the plant has been gathered. Habitat near base of beech stump, Home Farm, Grange Park, Alresford, Hants, 15th December, 1900. Rev. W. L. W. Eyre.

Collybia veluticeps Rea.

Pileus 3-6 cm. broad, fulvous tawny, convex at first then expanded, *velvety;* flesh pale then yellowish, thick at the centre but attenuated at the margin which remains for some time involute. Stem 4-7 cm. long × 5-15 mm. thick, stuffed then hollow, of the same colour as the pileus but paler above, *fusiform* extending into the long rhizomorphoid abundant mycelium, *striate*, only slightly velvety at the thickest part, flesh somewhat rufous at the base. Gills 5-8 mm. broad, deep ochre, sinuato-adnate, distant. Mycelium *cordlike, branched and proliferous.* Spores 7-8 × 3-4 μ oblong.

Caespitose. Found by Mr. W. H. Edwards growing in the interior of an old rotten elm stump, Northwick, Worcestershire, 19th January, 1896.

Distinguished by its velvety pileus, striate, fusiform, fasciculate stem, which is only slightly velvety at its thickest part and the cord-like branched proliferous mycelium.

Mycena carneosanguinea Rea.

Pileus 2½-3 cm. broad, livid grey tinging to rufous at the umbo, becoming paler when old, convex, sub-umbonate, smooth, flesh moderately thick at the centre gradually attenuated to the margin, white then *changing to blood red.* Stem 4 cm. long × 5-9 mm. thick, grey, yellowish and incrassated at the base, hollow, flesh at the apex tinged blood colour, at the base white and with short mycelial strands attached thereto. Gills 5 mm. broad, dull purplish brown, edge dark purple and denticulate, broad in front and adnate. Spores elliptical 4-5 × 2-3 μ.

On the ground, Raincliffe Woods, Scalby, Yorkshire, 31st August, 1894. Distinguished amongst the Callodontes by the flesh turning to blood red on section.

* By the generosity of our member, the Rev. W. L. W. Eyre, we now place the reproduction of this species of Bresadola before our Members.

Coprinus squamosus Morg. Jour. of Cincinnati Soc. of Nat. Hist., Vol. VI., 1883, p. 174, pl. 8.

Pileus somewhat membranaceous, ovoid, then expanded, cinereous, *covered with reddish-brown scales.* Stem hollow, rather equal;—below the annulus *covered with reddish-brown scales* like those of the pileus;—above the annulus, smooth and white. Gills free, ventricose, white, then reddish-brown, finally black. Spores cymbiform 9-10 × 5 μ.

Growing about old stumps and trees in woods. Caespitose, pileus about 1 inch in height, expanding to a diameter of $1\frac{1}{2}$-$2\frac{1}{2}$ inches, then split and revolute. Stem 4-6 inches long, about $\frac{1}{4}$ inch in thickness. This species is readily distinguished by its persistent reddish-brown scales upon the pileus and lower part of the stem.

At the base of Elms, Hanbury Park, Worcestershire, 28th September, 1900. Collected by Mr. Carleton Rea.

The following Members have joined the British Mycological Society.

Balfour, Professor Isaac Bayley, M.A., M.D., F.R.S., Inverleith House, Edinburgh.

Boston, The Mycological Club, Boston, Massachusetts, United States of America.

Macfie, Mr. John William Scott, Rowton Hall, Chester.

Mackenzie, Mr. D., 12 James Ward Street, Glasgow.

OFFICERS FOR THE SEASON 1899–1900.

President: H. Marshall Ward, D.Sc., F.R.S., &c., University Botanical Laboratory, Cambridge.

Hon. Secretary and Treasurer: Carleton Rea, B.C.L., M.A., 34, Foregate Street, Worcester.

THE EXETER FORAY.

23rd to 28th September, 1901.

The fifth annual week's Fungus Foray was held at Exeter, where the Governors of the Royal Albert Memorial College had kindly placed a room at the disposal of the British Mycological Society. This room was constituted the headquarters, and there the specimens collected from day to day were set out, the Presidential and other papers read, and the business of the Society transacted.

On Monday, the 23rd of September, the members assembled at Exeter, and in the evening at the headquarters found a few exhibits on the tables, viz., *Lepiota leucothites* Vitt., collected by the Rev. W. L. W. Eyre. *Amanita Vittadinii* Morett.; *Boletus aurantiporus* Howse., *radicans* Pers. and *Cronartium ribicolum* Dietr., collected by Dr. C. B. Plowright. *Lactarius controversus* Fr., collected by Mr. J. Rose. *Volvaria bombycina* Schaeff., collected by Mr. C. T. M. Plowright, and *Geaster fimbriatus* Fr., *Tricholoma scalpturatum* Fr. and *Sparassis crispa* Fr. (the two latter from Dawlish) collected by Mr. C. Rea.

On Tuesday, the 24th of September, the Newton Woods at Saint Cyres were explored, and subsequently the Squire and Mrs. E. H. Quicke kindly entertained the members to tea.

In the evening the Society's dinner was held at the Rougemont Hotel, and at the headquarters afterwards Professor H. Marshall Ward, D. Sc., F.R.S., delivered his Presidential address, entitled, "Some Methods employed in the investigation of Fungi." (See p. 166).

On Wednesday, the 25th of September, the Whitestone Woods, near Newton Saint Cyres, were carefully searched. Dr. C. B. Plowright found growing on birch *Femsjonia luteoalba* Fr., a genus of the Tremellineæ hitherto unrecorded for Britain, and Mr. Biffen secured *Hymenogaster tener* Berk.

In the evening the business meeting of the British Mycological Society was held at the headquarters. Professor James W. H. Trail, M.D., F.R.S., was unanimously elected President for the ensuing year, and Mr. Carleton Rea, B.C.L., M.A., Hon. Sec. and Treasurer. It was also resolved that the office of Vice-President should be created and the rules altered accordingly, and Dr. C. B. Plowright was unanimously elected to that position. The Hon. Secretary was

further directed to make the membership cards date for one year only, and not from season to season as had previously been done.

The invitation of The Woolhope Naturalists' Field Club to hold their next annual week's foray at Hereford was considered, and provisionally accepted subject to the approval of Professor J. H. W. Trail.

The Hon. Treasurer and Secretary reported that he had at that date a balance in hand of £14 0s. 0d., which was entirely due to the printing fund, and that he must still earnestly invite members to contribute liberally to the same. At the present time he had five outstanding subscriptions to come in for the current season, but they had yet to pay for the Transactions, the Programme of that Foray, and other incidental expenses for the same period, thus showing that apart from the printing fund they had no means with which to do it.

78 foundation members had now been enrolled, of which number 55 might be considered as on the active list. 5 new members—Messrs. C. P. Bird, W. H. Burrell, Cecil H. Spencer Percival, and C. T. M. Plowright and Professor F. W. Oliver—had joined the Society since the last Transactions were printed; whilst 4 members —Messrs. F. T Mott, J. Needham, S. G. N. Spofforth and Herr Dr. Professor Rehm—had resigned.

Miss Annie Lorrain Smith then read her paper on "The fungi of germinating farm seeds" (see p. 182), and Dr. C. B. Plowright a short paper on "Ozonium auricomum" (see p. 181).

On Thursday, the 26th of September, the members drove to Columb John, from whence the Killerton Woods were thoroughly investigated and the somewhat scarce *Lepiota Badhami* B. and Br. was found in considerable abundance, growing under oaks and Spanish chestnuts. On the conclusion of the day's work, their fellow-member, Sir Charles Thomas Dyke Acland, most hospitably entertained the members to tea at Killerton.

In the evening at the headquarters Mr. Barker contributed a paper entitled, "Spore formation in Saccharomycetes" (see p. 187), and Professor H. Marshall Ward one on "Recent observations on Puccinia dispersa Erikss." (see p. 179). Dr. C. B. Plowright then gave a demonstration of the 250 specimens set out for exhibition in the room. The President next drew the attention of the members to the fact that only a few numbers of the first Transactions were left for sale, and it was unanimously decided that the Hon. Secretary should be directed to part with no further copies except as a complete set with the next number of the Transactions, which would complete their first volume, and at an increased price.

A hearty vote of thanks was then accorded to the landowners who had so kindly granted to them permission to visit their estates, to Mr. E. H. Quicke and to Sir Charles Thomas Dyke Acland for their generous hospitality, to Mrs. Amy Montague for the able

arrangement of the daily forays, and to the Governors of the Royal Albert Memorial College, Exeter, for the loan of the room.

On Friday, the 27th September, some more woods adjacent to Newton Saint Cyres were searched, and *Femsjonia luteoalba* Fr. was again found, this time growing on oak. Miss A. Lorrain Smith gathered a mould new to the British Fungus Flora *Helminthosporium obclavatum* Sacc., and also specimens of the somewnat rare *Sporochisma mirabile* B. and Br. In the annexed list over 400 species are enumerated as the result of the week's foray.

Complete List of Fungi gathered during the Foray.

Amanita phalloides Fr., mappa Fr., pantherina Fr., muscaria Fr., rubescens Fr., spissa Fr., adnata W. G. Smith=junquillea Quélet.

Amanitopsis vaginata Roze.

Lepiota procera Scop., permixta Barla, rachodes Vitt. and vār puellaris Fr., excoriata Schaeff., mastoidea Fr., Badhami Berk., metulæspora B. and Br., cristata A. and S., erminea Fr., holosericea Fr., leucothites Vitt., granulosa Batsch., amianthina Scop.

Armillaria mellea Vahl., mucida Schrad.

Tricholoma sejunctum Sow., resplendens Fr., acerbum Bull., flavobrunneum Fr., albobrunneum Pers., pessundatum Fr., rutilans Schaeff., scalpturatum Fr., vaccinum Fr., terreum Schaeff., saponaceum Fr., cuneifolium Fr., virgatum Fr., carneum Bull., nudum Bull., melaleucum Pers., sordidum Fr.

Clitocybe nebularis Batsch., odora Sow., rivulosa Pers., cerrusata Fr., phyllophila Fr., candicans Pers., dealbata Sow., infundibuliformis Schaeff., geotropa Bull., flaccida Sow., fragrans Sow.

Laccaria laccata Scop.

Collybia radicata Relh., platyphylla Fr., fusipes Bull., maculata A. and S., butyracea Bull., velutipes Fr., vertiruga Cke., confluens Pers., tuberosa Bull., esculenta Wulf., acervata Fr., dryophila Bull.

Mycena pelianthina Bolton, aurantio-marginata Fr., pura Pers., luteoalba Bolton, polygramma Bull., galericulata Scop., rugosa Fr., ammoniaca Fr., alcalina Fr., filopes Bull., amicta Fr., debilis Fr., hæmatopoda Pers., sanguinolenta A. and S., galopoda Fr., leucogala Cke., epipterygia Scop., clavicularis Fr., tenerrima Berk.

Omphalia fibula Bull.

Pleurotus ostreatus Jacq.

Volvaria Taylori Berk.

Pluteus cervinus Schaeff.
Entoloma jubatum Fr., sericellum Fr., sericeum Fr., nidorosum Fr.
Clitopilus prunulus Scop., orcella Bull., carneo-albus Wither.
Leptonia lampropoda Fr., serrulata Fr., chalybea Pers., incana Fr.
Nolanea pascua Pers., mammosa Fr.
Claudopus variabilis Pers.
Pholiota terrigena Fr.=Cookei Fr., togularis Bull., spectabilis Fr., adiposa Fr., mutabilis Schaeff.
Inocybe pyriodora Pers., Bongardii Weinm., fastigiata Schaeff., rimosa Bull., asterospora Quél., eutheles B. and Br., geophylla Fr.
Hebeloma fastibile Fr., glutinosum Lindgr., mesophæum Fr., crustuliniforme Bull.
Flammula alnicola Fr.
Naucoria melinoides Fr., semiorbicularis Bull., escharoides Fr.
Galera tenera Schaeff., hypnorum Batsch.
Tubaria furfuracea Pers., crobula Fr.
Crepidotus mollis Fr.
Agaricus campestris Linn. and vār silvicola Vitt., arvensis Schaeff., xanthoderma Genev., pratensis Schaeff., hæmorrhoidarius Schulz., comptulus Fr.
Stropharia æruginosa Curt., squamosa Fr., semiglobata Batsch.
Hypholoma sublateritium Schaeff., capnoides Fr., fasciculare Huds., velutinum Pers., appendiculatum Bull., hydrophilum Bull.
Psilocybe sarcocephala Fr., semilanceata Fr., fœnisecii Pers.
Psathyra corrugis Pers., fibrillosa Pers.
Anellaria separata Karst., fimiputris Karst.
Panæolus phalænarum Fr., sphinctrinus Fr., campanulatus Fr.
Psathyrella gracilis Fr., atomata Fr., disseminata Pers.
Coprinus atramentarius Fr., picaceus Fr., niveus Fr., micaceus Fr., lagopus Fr., plicatilis Fr.
Bolbitius tener Berk.
Cortinarius (Phlegmacium) triumphans Fr., largus Fr., infractus Pers., multiformis Fr., calochrous Fr., purpurascens Fr., and var subpurpurascens Fr., dibaphus Fr., prasinus Fr.
(Myxacium) collinitus Sow., mucifluus Fr., elatior Fr., delibutus Fr., pluvius Fr.
(Inoloma) violaceus Linn., alboviolaceus Fr., pholideus Fr.
(Dermocybe) caninus Fr., anomalus Fr., lepidopus Cke., cinnamomeus Fr.
(Telamonia) torvus Fr., hinnuleus Fr., hemitrichus Fr.
(Hydrocybe) subferrugineus Fr., armeniacus Fr.
Gomphidius gracilis Berk.
Paxillus involutus Fr.
Hygrophorus chrysodon Fr., virgineus Wulf., conicus Fr., calyptræformis Berk., chlorophanus Fr., psittacinus Schaeff.

Lactarius torminosus Schaeff., turpis Fr., controversus Pers., blennius Fr., circellatus Fr., uvidus Fr., pyrogalus Bull., vellereus Fr., deliciosus Fr., pallidus Fr., quietus Fr., rufus Scop., aurantiacus Fr., serifluus Fr., subdulcis Fr.

Russula integra Fr., lutea Fr., armeniaca Cke., cærulea Fr., nitida Fr., puellaris Fr., nigricans Fr., adusta Fr., furcata Fr., lepida Fr., vesca Fr., depallens Fr., cyanoxantha Schaeff., fellea Fr., drimeia Cke., ochroleuca Fr., emetica Fr., fragilis Fr.

Cantharellus cibarius Fr., Friesii Quél., aurantiacus Fr., tubæformis Fr., infundibuliformis Fr.

Nyctalis asterophora Fr., parasitica Fr.

Marasmius peronatus Fr. oreades Fr., erythropus Fr., rotula Fr., androsaceus Fr., Hudsoni Pers., epiphyllus Fr.

Lentinus cochleatus Fr.

Panus stipticus Fr.

Lenzites betulina Fr.

Boletus luteus Linn., elegans Schum., flavus Wither., granulatus Linn., tenuipes Cke., badius Fr., piperatus Bull., chrysenteron Fr., subtomentosus Linn., radicans Pers., edulis Bull., crassus Mass., luridus Schaeff, laricinus Berk., scaber Fr.

Fistulina hepatica Fr.

Merulius lachrymans Fr., corium Fr.

Dædalea quercina Fr.

Poria vaporaria Fr., medulla-panis Fr., blepharistoma B. and Br., sanguinolenta A. and S.

Polystictus perennis Fr., versicolor Fr., radiatus Fr. abietinus Fr.

Fomes ulmarius Fr., annosus Fr., applanatus Walhr.

Polyporus Schweinizii Fr., rufescens Fr., squamosus Fr., giganteus Fr., sulphureus Fr., dryadeus Fr., hispidus Fr., betulinus Fr., adustus Fr., fibula Fr.

Hydnum repandum Linn. and vār rufescens Pers., zonatum Batsch., auriscalpium Linn., farinaceum Pers., udum Fr.

Irpex obliquus Fr.

Radulum fagineum Fr.

Phlebia merismoides Fr.

Grandinia granulosa Fr.

Craterellus cornucopioides Pers., sinuosus Fr.

Thelephora caryophyllea Pers., laciniata Pers.

Stereum ochroleucum Fr., purpureum Pers., hirsutum Fr., rugosum Fr., sanguinolentum A. and S.

Auricularia mesenterica Fr.

Corticium giganteum Fr., calceum Fr., quercinum Fr., incarnatum Fr., comedens Fr.

Sparassis crispa Fr.

Clavaria fastigiata Linn., muscoides Linn., cinerea Bull., cristata Pers., rugosa Bull., flaccida Fr., inæqualis Fl. Dan., vermiculata Scop., fragilis Holmsk., pistillaris Linn.
Calocera viscosa Fr., cornea Fr., stricta Fr.
Tremella mesenterica Retz., albida Huds., lutescens Pers.
Hirneola auricula-Judæ Berk.
Femsjonia luteoalba Fr.
Dachryomyces deliquescens Dub., stillatus Nees.
Hymenogaster tener Berk.
Scleroderma vulgare Fr., verrucosum Pers.
Crucibulum vulgare Tul.
Cyathus striatus Hoffm.
Lycoperdon excipuliforme Scop., saccatum Vahl., gemmatum Batsch., pyriforme Schaeff., perlatum Pers., cælatum Bull., bovista Linn., plumbeum Pers., nigrescens Vitt.
Ithyphallus impudicus Fisch.
Mutinus caninus Fr.
Ceratiomyxa mucida Schroet.
Craterium pedunculatum Trentepohl.
Stemonitis fusca Roth.
Trichia fallax Pers.
Arcyria punicea Pers., incarnata Pers.
Lycogala miniatum Pers.
Cylindrium flavo-virens Bon.
Aspergillus glaucus Link.
Penicillium glaucum Link.
Sepedonium chrysospermum Fr.
Asterophora agaricicola Corda.
Rhinotrichum ramosissimum B. and C.
Sporotrichum chlorinum Link.
Hormiscium hysterioides Sacc.
Zygodesmus fuscus Corda.
Helminthosporium fusiforme Corda., obclavatum Sacc.
Acrothecium tenebrosum Sacc., obovatum Cke.
Sporochisma mirabile B. and Br.
Isaria farinosa Fr.
Tubercularia vulgaris Tode.
Puccinia lychnidearum Link., obscura Schröt. (the aecidious condition)
Phragmidium rubi Pers.
Uredo Mülleri Schröt. (the uredo condition of Phragmidium albidum (Kuhn.)
Cronartium ribicolum Dietr.
Nemaspora crocea Pers.
Spinellus fusiger Van Tiegh.
Sphærotheca pannosa Wallr.
Uncinula adunca Lév.

Erysiphe Montagnei Lév.
Eurotium herbariorum Link.
Rhytisma acerinum Fr.
Bulgaria polymorpha Wettstein.
Coryne sarcoides Tul.
Mollisia cinerea Karst.
Helotium citrinum Fr., virgultorum Karst.
Belonidium pruinosum Mass.
Ciboria echinophila Sacc., ochroleuca Mass. = firma Pers.
Chlorosplenium æruginosum De Not.
Tapezia cæsia Fckl.
Dasyscypha virginea Fckl., calycina Fckl.
Peziza vesiculosa Bull.
Otidea aurantia Mass.
Helvella lacunosa Afzel.
Leotia lubrica Pers.
Epichloe typhina Berk.
Hypomyces aurantius Tul.
Nectria cinnabarina Fr., ditissima Tul.
Xylaria hypoxylon Grev.
Ustulina vulgaris Tul.
Daldinia concentrica Sacc.
Quaternaria Persoonii Tul.
Chætosphæria phæostroma Fuckl.
Trichosphæria pilosa Fuckl.

ADDRESS BY THE PRESIDENT.

Professor H. MARSHALL WARD, D.Sc., F.R.S., F.L.S., F.R.H.S., Cambridge.

Ladies and Gentlemen,

During this, my second year of tenure of the office you have done me the honour to confer on me, suggestions have been made to the effect that some account of the methods used in botanical laboratories for the study of Fungi would be at least acceptable to amateurs, and very useful to those who concern themselves more closely with mycology.

Personally, I am of the opinion that a man must make his methods as he proceeds, and that it very rarely happens that mere descriptions of the technique of others help one much; but although this is true of details, it would be absurd to refuse to admit that we can all learn something from each other in regard to general processes, and I need hardly say it will give me the greatest pleasure to comply with the request that I should put into a few words some descriptions of the methods employed in my own and similar laboratories, and that if anything said by me to-night should be really of use to any of you, it will add keen satisfaction to the pleasure.

It is obvious that in the time at our disposal my remarks can amount to nothing beyond a bare outline of an immense subject, but, as I understand it, that is what is required—a sketch of the technique of modern mycology.

Methods of killing, fixing, hardening and preserving Fungi are now numerous. Few fungi can be satisfactorily observed on mere drying, except superficially and for the comparative purpose of the systematist. For Herbarium purposes it is usual to dry the specimens by pressing them between paper, as with higher plants, and this is quite satisfactory in the case of most epiphytes or parasites on leaves, twigs, paper, &c., where the substratum can be employed, or in the case of the harder Polyporei, *Corticium*, &c.

In the case of the larger fleshy Hymenomycetes much can be done by the well known spore-maps obtained by allowing the

spores to fall gently on to paper placed beneath the gills &c., and fixing them with collodion; and by means of carefully dried sections, and I have seen very satisfactory preparations dried in sand and kept in boxes.

Nevertheless both in the case of the larger fleshy fungi, and in that of the delicate mould fungi—e.g., Mucedines and Hyphomycetes—no preparations equal those kept in properly stoppered bottles of preservative fluids, and when it comes to gelatinous and aquatic fungi I know of no other way of keeping them at all, if they are to be examined afterwards.

At the outset it has to be admitted that no fluid preserves the delightful colours in all their beauty, and drawings are absolutely necessary as adjuncts to any complete collection. Some success is claimed, however, for recent attempts with various fluids.*

Of the fluids employed absolute alcohol is no doubt the most satisfactory and simplest, and it becomes diluted by the water it abstracts from the larger forms sufficiently to counteract the disadvantageous brittleness brought about in smaller species.

But it must be remembered that alcohol in all its forms induces changes which render objects preserved in it useless for any but comparatively rough and superficial observation later. Moreover, absolute alcohol is expensive, and the various cheaper forms of alcohol, methylated spirit, &c., cause contractions and distortions, and entail other drawbacks in even greater degrees.

Formalin is excellent for many purposes of preserving, but its keeping powers are limited, and although it often preserves colours for many months, it softens and injures the tissues.

Much can be done in special cases with glycerine, carbolized media, and even gelatine, but none of these media afford really permanent preparations which can be examined after the course of months or years with results much better than those obtainable in properly dried specimens.

The primary causes of failure in all the foregoing cases are two—(1) The contractions caused by the sudden or unequal extraction of the water of organisation and of the cell-sap; and (2) chemical and physical changes in the soluble cell-contents and protoplasm, involving not only loss of colour but many more subtle alterations.

There are, however, two methods of so preserving fungi that even after the lapse of years all but the most refined details can be made out, and which may be specially recommended to the notice of collectors. Both are available for the purposes of the traveller and museum curator, as well as for those of the laboratory worker, and I would strongly urge their adoption by collectors who wish to have their material properly preserved for subse-

* See Lutz, Bull. Soc. Mycol. de Fr., T. xvii., 1901, p. 302.

quent examination. One of these methods is extremely easy and quick in its action, and although the penetration into larger fungi may have to be facilitated by puncturing, slashing, or cutting the specimen if it is intended for histological examination, I have obtained excellent results with it for museum purposes by merely plunging a *Boletus* or Agaric into the medium as a whole.

The hardening and fixing fluid is prepared by adding a few drops of concentrated acetic acid to a solution of corrosive sublimate in water, and allowing the specimen to soak in this for 24 hours or more, after which it may be bottled in alcohol without more ado.* The corrosive sublimate—mercuric chloride, $HgCl_2$—is, I need hardly remind you, a dangerous poison, but it has the advantage of being easily carried in crystals and made up as required.

Small fleshy fungi, such as species of *Mycena*, *Coprinus*, *Leotia*, &c., and gelatinous forms, such as *Exidia*, *Auricularia*, &c., as well as delicate moulds like *Mucor*, *Pilobolus* or parasites like *Saprolegnia*, *Peronospora*, *Cystopus*, &c., can be beautifully fixed and preserved by this means.

If you want the best attainable results, however, in the way of perfect fixation and hardening for histological purposes, I would recommend the following much more troublesome method, the principal drawbacks to which are, that it is extremely difficult to carry out the very thorough washing process (absolutely necessary for success) when travelling or away from the laboratory, and that the solutions and alcohols are so much more complex.

The specimens—whole or in pieces according to their size and consistency—are plunged fresh into weak Flemming's solution for 12-24 hours or even longer. They are then washed in running water for at least the same period, until every trace of the fixing fluid is removed, and then transferred to the following in succession, in each of which the specimens should remain for 12-24 hours—viz., 30 per cent., 50 per cent., 70 per cent., and 90 per cent. alcohol. Here they may remain for transmission or for further treatment to be referred to subsequently.

For some purposes it will be regarded as a disadvantage that the osmic acid in the Flemming's solution† stains the objects black,

* A good formula is that of Keiser's solution—
$HgCl_2$ = 5 grams.
Water = 300 c.c.
Acetic Acid = 3 grams. [See, for instance, Strasburger *Das Botanische Practicum*, 3rd ed., p. 50.]

†A suitable solution is :—

Chromic Acid	0·25	per cent.
Osmic Acid	0·1	,,
Acetic Acid	0·1	,,
Water	99·73	,,

(See Strasburger l. c. or any of the histological manuals.)

but this can be removed at any time by means of hydrogen peroxide. I have frequently prepared museum specimens of fleshy or even gelatinous fungi by these means, so that they remain permanently as firm as india-rubber and without contraction, and although they gradually deteriorate for histological purposes afterwards—*e.g.*, as regards staining properties, &c., if kept long in alcohol, and especially if kept in absolute alcohol—even this can be got over to some extent by keeping them in a mixture of alcohol, glycerine, and water.

These are by no means the only methods which have been devised for hardening, fixing and preserving fungi, but I have selected them as two of the best known to me for general purposes, and of wide application to practically all the forms the collector is likely to wish to put up in bottles.

I now pass to consider methods of histological examination—*i.e.*, the investigation by means of the microscope of the finer structure of the fungi.

We need not dwell on the ordinary cases of direct inspection of the collected fungus by means of the pocket-lens or microscope, except that I wish to emphasize my own conviction that just as much valuable work has been done in the past by means of the lens and accurate descriptions of the forms gathered together and examined at once in the fresh state, so much still remains to be done, and certainly some of the finest training possible in out-door natural history is obtainable by the cultivation of these habits of direct observation in the field. Moreover, as we shall see when we come to study culture-methods, direct observation of the living fungus yields results unattainable by any manipulation of dead forms, however well preserved and prepared.

When all is said and done, however, there remain numerous problems only to be solved by the examination of prepared material—*e.g.*, questions concerning the nature of the cell-wall and contents, nuclei, spore-formation, sexual organs, and so forth—and with some of the more minute fungi their very existence is hardly demonstrable in the fresh condition. The same applies especially to many parasites in vegetable and animal tissues, and it is marvellous what striking results can be obtained with properly prepared sections, as compared with the rough glimpses at the general state of affairs, with which our ancestors had to be content.

I know, moreover, that I am expected to say something as regards methods both of staining and of section-cutting, and thus to enter on dangerous ground for the amateur; and at the outset you must allow me to express my firm conviction that more time can be wasted in this branch of work, and more trifling results

obtained, than in any other domain of science that has had the misfortune to become the hobby of the dilettante, not even excepting the collecting of dried plants. Personally, I am strongly in favour of eliminating all but one or two well tried methods of staining capable of very general application, and in the present instance shall confine myself to two only, which I have myself found to be extremely valuable.

There are several methods of hardening and staining the more delicate fungi for the purpose of permanent microscopical preparation, of which we may select the following as one which has been found generally useful.

Suppose we have a satisfactory growth of such a form as a *Saprolegnia*, growing on a fly floating in water, or of a *Mucor* developed on a piece of fruit, bread, &c. In such cases the whole mass may be thrown into the weak Flemming's solution and be killed, fixed, and hardened in one operation, the washing and passage through the alcohol being very thoroughly and carefully accomplished as before.

The material having reached the last stage of hardening, in absolute alcohol, is then placed bodily into a dilute solution of iron-alum, and left there for several hours until thoroughly penetrated by this re-agent.

This done, the fungus is transferred to water for a few seconds, to remove the adhering excess of alum, and then cast into a very dilute staining fluid made up in various ways, of which the following extremely simple one is perhaps as good as any:—5 grams of Haematoxylin dissolved in a litre of distilled water. Almost any desired depth of staining can be obtained by this solution, if attention is paid to the thorough washing out of the iron-alum, bleaching by means of hydrogen peroxide if necessary, or partially decolourising by re-immersion in iron-alum, and so on.*

The properly stained fungus is now passed again gradually through the alcohols, to prevent contraction when transferred finally to xylol and Canada balsam, or to glycerine and glycerine jelly for final mounting.

Let us now suppose that we have to deal with large fungi, or with parasitic forms, such as *Puccinia*, *Æcidium*, &c., in leaves or other parts, which are too opaque and bulky to mount whole, and which must be examined by means of sections.

Again there are various methods which may be employed or modified in different cases, and again we will select one which I know from extensive practical experience to be generally useful.

*For further details as to these processes the reader is referred to handbooks on histology, such as those already cited, or Chamberlain *Methods in Plant Histology*, Chicago, 1901.

The material having been properly hardened in Flemming's solution, and then in the graduated alcohols, is placed in absolute alcohol for 24 hours, then in a mixture of absolute alcohol and chloroform until it sinks, and from this is transferred successively to pure chloroform, to a mixture of chloroform and paraffin kept at a uniform temperature of about 58° C. and finally to pure paraffin wax with a melting point of 58°. Here it remains until the melted paraffin has penetrated every part of the hardened mass, which may take several days.

The melted matrix with its embedded piece of material is now poured into a small cuboidal mould, and allowed to set, care being taken to orientate the fungus so that we know the direction of its various axes, and with certain precautions the whole is cooled in water, and turned out of the mould as a solid block, hard enough to hold the material fixed, but sufficiently soft to allow a sharp razor to pass bodily through fungus and wax together.

This block, again properly orientated, is now affixed to a holder so arranged that the razor shaves off slice after slice, and the thin sections are secured as they come off and arranged for mounting.

I am not here concerned with mechanical details devised to ensure definite thickness of sections, their sequence, in ribbons or otherwise, &c., and pass on to consider the further fate of the sections themselves.

Each section is a clean cut slice of wax, firm enough to hold the embedded finely cut fungus in place, and if we lay the whole in some reagent which dissolves the wax, we have only the finely cut piece of fungus left, which will probably tumble to pieces or crumple up owing to the loss of its supporting wax matrix.

To avoid this the sections are arranged on a glass slide on a thin film of white of egg, and allowed to remain there till the latter dries and glues them in place by means of its adherence to the clean cut walls.

Now we can dissolve out the paraffin wax and have our fungus sections fixed *in situ* for further examination.

Following the procedure of the method here chosen, this is done as follows:—The slide with its adherent sections is placed in xylol, which rapidly dissolves the paraffin wax, but has no solvent action on the transparent film of egg-white cementing the sections to the glass. From the xylol the slides are transferred to absolute alcohol, and after this has replaced the last trace of xylol the sections are ready for staining.

The staining may be done as before, by first soaking the sections in iron-alum, and then, after washing in water, transferring them to dilute Haematoxylin, passing through the

alcohols, to xylol, and finally mounting in Canada balsam. Or, and here I am about to describe the second of the two methods promised above, the following much more complex procedure may be adopted when certain finer histological details concerning the protoplasm and nuclei are in question.

The slides with their adherent sections are removed from the alcohol to a solution of the intense red dye Safranin, and left in this for several hours. When deeply stained, they are rapidly rinsed in water, and if necessary in alcohol to remove excess of the dye, and then plunged into a dilute watery solution of gentian violet, and again left for some minutes to an hour or more, until they appear deep blue-purple. After another quick washing, to remove excess of adherent dye, they are put for a few minutes into a bath of a 1 per cent. solution of a dye known as Orange G., which exerts some peculiar action facilitating the removal of the excess of the violet without at the same time washing out the Safranin. The preparations are then finished in absolute alcohol, transferred to clove-oil, and finally mounted in balsam.

It is impossible here to go into all the small points which have to be attended to in obtaining the proper intensity of staining, dehydration, &c., in this admittedly complex method,* but the results in a successful preparation where the more solid parts of the nuclei are brilliant red, other granules violet, and the nuclei and chlorophyll-granules of the host-plant picked out in equally sharp colours, are worth the trouble in certain cases.

I now leave the subject of methods of investigating the dead structures, and proceed to the consideration of methods of culture and examination of the living fungus; methods which are, in my opinion, of more importance in the present state of science, and destined to teach us far more of the nature of these extraordinary organisms. It is obvious at the outset that our methods must differ according to the kind of fungus we are going to cultivate; not only will saprophytes behave very differently from parasities, but each group presents its own problems in cultivation, and many of these problems are as yet unsolved.

Commencing with saprophytes, as the easier to deal with in practice, I distinguish between methods of isolation and methods of culture proper. Suppose, for instance, that we have gathered a species of *Mucor*, *Sporodinia*, *Phycomyces*, *Rhizopus*, or other easily grown Mucorine, the probability of our obtaining a pure culture by direct sowing of the spores on any medium is almost infinitely remote. Indeed it is sheer waste of time to attempt it in most cases, since the following simple method of isolating the fungus from its contaminating bacteria, moulds, &c., can be so readily employed.

* See, for further details, Zimmerman, Hoff, *Botanisches Centralblatt*, 1898, vol. 76, p. 66.

I take a tube of sterile water, and shake up the spores of the *Mucor* thoroughly in it, thus distributing the spores of the fungus, and any impurities present, far apart in the liquid.

I then take a sterile tube of gelatine, rendered nutritious by the addition of some vegetable extract and melted by placing the tube in water at 25° C., and transfer a few drops of the above emulsion of mixed spores to the liquid gelatine medium. A sharp shake up separates spores and impurities even further apart than before, and now the contents of the tube are poured on to a perfectly sterile glass plate, on which the gelatine rapidly flows in a thin film and sets to a firm clear jelly. In this jelly there will now be imbedded, at various distances apart, the spores of the *Mucor* and those of the foreign contaminants from which separation is desired. In a few hours—it may be 12, 24, or 48 or more—each isolated spore will begin to germinate in its fixed position if the conditions suit it, and since we can observe this under a microscope it is not difficult to pick out the young mycelium as it develops with a sterile needle and transfer it bodily to a new sterile tube of the culture medium.

If the original sowing of contaminated material contained many spores, however, it may be that this first "isolation plate" will still be far too crowded to allow of our picking up only one mycelium, therefore I almost invariably proceed as follows:—

Having shaken the spore material in the distilled water, I have ready 6 gelatine tubes, which we may call A, B, C, &c., standing in water at 25° C., and 6 plates to be labelled *a*, *b*, *c*, &c. I then make the first plate (*a*) as already described, but take care to pour into it only about 9-10ths of the spore-laden gelatine of the tube A.

The tube A is then filled up with the spore-free gelatine of tube B, thus distributing—by shaking—its remaining 1-10th of spore-laden gelatine into the newly added gelatine, and again 9-10ths of this are poured into a second plate (*b*), where it runs and sets as before. Now it is evident that the plate *b* will only contain about 1-10th as many spores altogether as does the plate *a*, and since these are distributed over an equal area they are more widely separated one from another. I then take a third tube of spore-free gelatine and add its contents to the tube A, in which 1-10th of the spore-laden gelatine remains—*i.e.*, about 1-100th of the original spores—and repeat the process, and so on to the fourth, fifth, and sixth.

Obviously, then, each successive plate will contain theoretically 1-10th of the number of spores previously sown: so that if plate *a* has 10,000 spores, *b* will have 1000, *c* only 100, and *d* only 10, the fifth (*e*) only 1, and the sixth plate (*f*) none. And in practice it is found that a properly made series of plates has fewer and

fewer spores, more and more isolated after each dilution, in proportions sufficiently like this to make the illustration applicable.* Of course, experienced hands and eyes soon learn to appreciate the relative sizes and numbers of the spores and impurities to be dealt with in the first instance. If one has a good, clean growth of the *Mucor* to begin with, with up-standing sporangia yielding plenty of clean spores to a touch of a moist needle point, hardly any trouble will be met with, and the second or third plate will probably yield perfectly pure and well isolated mycelia; but if the original spore material is derived from a rotting fruit, or macerated tissues, for instance, there may be far more bacteria, infusoria, and moulds, &c., than *Mucor* spores, and it may result that even the sixth plate was not sufficiently dilute, and other series have to be made with the partially purified material, until perfect isolation is at last assured.

Troublesome and tedious though this method may at first sight appear, I have found that it is the shortest in the end wherever it is seen at the outset that the fungus desired will grow on such a medium as the gelatine referred to. This is by no means always the case, however, and even such substitutes for gelatine as agar, apple-jelly, quince-mucilage, &c.—all of which I have used with more or less success in special cases, as well as the curious mineral silica jelly, so difficult to prepare and use successfully—fail with many fungi. It would take us too far to discuss the special methods which may be employed for isolation in such cases, as well as to enumerate the many fungi which have hitherto resisted all attempts of the kind.

It may surprise some of you to learn that *Saprolegnia*—its name refers to its habitat in putrid substances, swarming with bacteria and infusion—can be isolated and grown in pure culture on artificially prepared media, yet such is the fact. If we place a small tuft of actively growing *Saprolegnia* at a time when the zoosporangia are just emitting their zoospores, in water sterilised by a Pasteur filter and in which a few sterilised flies have been cast, a few hours suffice for infection and the development of nearly bacteria-free growths from which re-infection on sterilised flies' legs can easily be got.

On placing such a preparation on the sloped surface of gelatine prepared with extract of meat—of course properly sterilised—the fungus rapidly grows out in a radiating fringe round the fly's leg, and from the outer edges of this halo-like fringe pieces can be obtained almost devoid of bacteria. Such a piece, transferred to another tube, gives a still cleaner culture, and by repeated transferences to new tubes, pure cultures are at length obtained. Or boiled peas can be employed instead of the gelatine, as Klebs has shown.

* The method is a particular modification of a procedure known generally in all bacteriological and botanical laboratories.

Such pure growths are quite infertile, however, and remain so for months or years, though we can obtain zoospores or oospores at any time in a few hours by transferring a piece to water or food materials in water. It is interesting to note that Trow* has recently applied a similar method for obtaining pure cultures of a *Pythium*, modifying the procedure in so far that he obtains his material from the ærial hyphæ developed from the surface of the solid material.

Having isolated our fungus, the next step is to cultivate it as a pure growth, and here we may aim at either one of two objectives: we may (1) wish merely to grow the fungus successfully in masses and observe its behaviour, much as a gardener desires to see the effect of a bed of annuals which he sows thickly, or (2) we may want to trace the details of germination and development of a single spore and plant under the microscope, much as a physiologist focusses his attention on a single plant grown from seed in a pot.

In illustration of the first case; among the more troublesome forms which can, nevertheless, be cultivated, may be mentioned the various wood-destroying Hymenomycetes—*e.g.*, species of *Stereum*, *Collybia*, *Armillaria*, &c. The principal difficulty in these cases is to obtain the isolated specimen to start with, but having obtained that its further growth is ensured by transferring it to a block of wood—due regard being had to the species it was found growing on—resting on a little moist cotton wool in a plugged tube, and thoroughly sterilised by heating in a steamer.

It by no means follows that you will bring such cultures to a successful issue, however, and I may take this opportunity of saying that the cultures of *Marasmius androsaceus* referred to in my last address† have not even yet, after two years culture, developed any trace of pileus. They are still alive, and apparently growing, but they yield no fructification. In the choice of food-materials, attention should be paid to what is known of the habits of the fungus. Most saprophytic fungi will endure, or even prefer, an acid medium, and in many cases this helps us to subdue intermixtures of bacteria on the isolation plates; but some—*e.g.*, *Saprolegnia*—are easily killed if the medium becomes acid. Again, it is a rule that fungi growing on dung or other animal débris succeed better on gelatine media with extracts of dung, &c., than do saprophytes normally met with on decaying fruit, roots, or other vegetable tissues. Indeed, I sometimes find that gelatine—an animal substance—acts like a

* Ann. of Bot., 1901, vol. xv., p. 269.

† pp. 139-40.

poison to such forms as will grow freely on sterilised slices of potato, carrot, banana, beet, artichoke, or on agar—a vegetable product—mingled with decoctions of plums, grapes, oranges, &c., or with beer-wort.

Passing now to the second case, just referred to, perhaps the most difficult of all processes, though it is at the same time one of the most valuable and interesting, is that of the isolation and germination of spores in hanging drops under the microscope. The end to be attained can be reached in various ways. Here will be described only the method I generally employ, using for illustration a spore of *Botrytis*, or any other which is large enough to be readily seen with a good hand-lens, because I want to describe how the ideal hanging-drop culture—where the drop contains only a single spore—may be prepared.

Having obtained a pure culture of *Botrytis* by separation on plates, and transferred it to a tube of some medium on which it readily grows and forms conidia—*e.g.*, wort-agar—we have in a few days abundant crops of the grey-brown spores.

A sterile platinum wire easily removes hundreds of such spores if passed through the crop, and these are shaken up in a tube of gelatine medium—*e.g.*, wort-gelatine—and thus disseminated through the mass as in the preparation of separation plates. On now dipping the point of a needle into the spore-laden gelatine, and touching a coverslip with it, a drop is obtained, and a glance with the microscope—or, in this case, even a good hand-lens—at once tells us whether the drop has brought with it one or more spores or not. If each of several trials yields no spore, the sowing in the tube was too small, and more spores should be added: if the sample drops contain many spores, more gelatine is to be added to the tube, until the average drop brings out only a few—say 1 to 10—spores. This object achieved, we may then proceed as follows:—

A number of glass culture-cells are to hand, already plugged and sterilised in large tubes holding three or four each. One of these is laid on a glass slide, hot from the Bunsen flame, and cemented to the slide by placing a bit of paraffin of M.P. 60° C. at the edge, where it melts and runs in, and solidifies as the slide cools, cementing the cell to the latter.

Meanwhile a number of thin cover-slips are placed between plates of talc, and sterilised by the Bunsen flames, and allowed to cool. Then sterile water is placed in each arm of the culture-cell, and the apparatus is ready.

Taking one of the sterile cover-slips held by forceps at one corner, a minute drop of gelatine from the spore-laden tube is placed in its centre, and the cover-slip rapidly inverted and laid on the culture-cell, to which it now forms the roof, the gelatine drop pendent from its lower side—a "hanging drop."

The microscope shows at a glance whether our drop contains a spore, or several, or none; in the latter case we repeat the drop-making process until a drop is obtained which contains *one* spore only. This result achieved the cover-slip is held in place by running in melted vaseline and wax, or any other suitable cement, and the culture is ready.

The drop is now placed under a microscope in such a position that the one spore is in focus: a careful drawing is then made, the time and temperature, as well as the distinguishing mark of the culture noted, and each stage of the germination, &c., observed as necessary.

It is, of course, in the study of the true parasitic fungi that the greatest difficulty in obtaining pure cultures must be expected, and in most cases no attempt has been made to overcome the apparently insuperable obstacles which obtrude themselves. For, let us see what a pure culture of a true parasite involves. As, before, we have to ensure a pure sowing of the spores of the fungus, and since such spores are in the ordinary course of events obtained from the host-plant, growing in the open and exposed to all kinds of wind-borne intruders, it is obvious that no such pure sowing is usually possible.

In the second place, we have to ensure a pure culture of the host-plant, and since this is commonly employed in the form of a seedling or pot-plant, growing in ordinary soil in a green-house or even in the open, no question of freedom from accidental infections or impurities can be entertained.

And, in the third and last place, we must put the conditions of the infected plant itself after inoculation. However carefully we cover up the specimen—even if as in some recent experiments by Eriksson, Klebahn and others, we place tubes or glass cases guarded with cotton-wool over them—we have no guarantee of purity of culture of either host or parasite.

Of course, in such infection experiments we rely on the following two principal factors in the results—(1) That infection occurs at a definite spot which we have marked beforehand as that where the sowing of spores was made on inoculation; and (2) that numerous repetitions of the infection—or attempts at such—yield consistent results, positive or negative as the case may be.

There arise questions, however, which make it highly desirable that pure cultures of both host and parasite should be obtained if possible, and I have recently been so fortunate as to carry into effect pure cultures of this kind even in the case of such exquisite parasites as the Uredineæ.

It is quite possible, as I have shown, to sterilise the "seeds" of grasses and germinate them in large glass-tubes on a plug of cotton-wool saturated with a suitable mineral solution, the orifice

of the tube being rendered germ-tight by a cotton-wool filter. The whole apparatus is, of course, previously sterilised by heat, and is so arranged that air may either be allowed merely to diffuse slowly in and out of the tube through the cotton-wool filter, or a supply of moist air, deprived of germs, be slowly and steadily drawn through the whole apparatus by means of an aspirator.

The "seed" soon germinates, and if the tube is properly exposed to suitable light, temperature, &c., the resulting seedling —a pure culture of the host-plant—will go on growing and unfolding new leaves for several weeks. Now I have recently succeeded in showing that if such a seedling is infected with a Uredine, normally parasitic on it, spore pustules of the latter result in due course, and if some of these spores be carefully removed from such a pustule and transferred to a second pure seedling of the grass, we have a pure culture of both host and parasite. For, although in the first infection a foreign spore or two may have been conveyed to the seedling, because we have at the outset to take our spores from an infected plant in the open, it is extremely unlikely that any contamination occurs in the second transference. At any rate, it is found in practice that very valuable results bearing on certain vexed questions of infection can be attacked by this method from new points of view.

As will readily be seen the method can also be employed with seedlings of Cress, Beech, Capsella, as well as various grasses and other plants, and infections of *Pythium*, *Phytophthora*, *Cystopus*, various Ustilagineæ and so forth, and I do not despair of extending it even to cases of perennial plants and to other parasitic fungi.

Here, however, it is time to bring to an end this sketch, and I have only to say in conclusion that it is in the application of the method and not in the apparatus that success lies. Methods are means, not ends, and to further point the moral we might travesty an old saying and declare that—It is men and not methods that are wanted.

The following communication is taken from the Annals of Botany, Vol. xv., No. lix., Sept., 1901.

THE BROMES AND THEIR RUST-FUNGUS (*Puccinia dispersa*).—I have for some time been occupied with an investigation which has involved a comparative examination of the "seeds" and seedlings of all the species and varieties of the genus *Bromus* that I could obtain, and a study of the conditions of infection of these grasses by the Uredo-form of *Puccinia dispersa*, the Rust-fungus so common on certain species of them.

The details of the results will, I hope, appear in due course, but some points of interest may be summarized now.

The uredo-spores germinate at all temperatures between about 10-12° C. and 25-27.5° C., which may be considered the minimum and maximum cardinal points; the optimum is about 18-20° C., and many failures in infection were found to be due to the fact that the leaves of the grass may be at temperatures above the maximum. Uredo-spores in water frozen for ten minutes into solid ice germinated on thawing, but freezing for two hours seems to kill them.

Infection experiments show that spores originating on a given species—*e.g.*, *B. mollis*—easily infect that species, but not necessarily another species, even if closely allied, and indeed may not infect all varieties of that species. Thus spores from *B. sterilis* easily infect *B. sterilis* and the closely allied *B. madritensis*, but not *B. mollis* or its allies *B. secalinus*, *B. arvensis*, &c., and not even the more closely allied *B. maximus*. Broadly speaking, the uredo-spores, growing on a species belonging to the *Serrafalcus* group, infect other members of that group—in varying degree, however, and not necessarily all—but fail to induce the development of pustules on species belonging to another group—*e.g.*, *Stenobromus* or *Festucoides*.

There is evidence, however, going to show that an occasional adaptation to another species may occur in cases where infection does not usually succeed. In such cases, the Uredo having once established itself on another species, its uredo-spore progeny will thenceforth readily infect that species.

The rule seems to be that the uredo-spores infect most easily the species and variety on which they have been developed, less easily varieties or species more remote, and fail altogether to gain a hold on more distant ones.

This does not appear to be a matter depending merely on the

structure of the leaves of the host plant, or on any recognizable excretion from them; at any rate the microscope shows none such, and experiments with *B. mollis* and *B. sterilis* demonstrated that the germ tubes grow readily in filtered extracts, boiled or unboiled, of the leaves. The matter evidently depends on the influence of the previous nutrition of the Fungus, as well as on the reactions of the species attacked, and presents problems of great complexity.

It is possible to grow pure cultures of the grass as well as of the Fungus for weeks and even months in closed and in ærated tubes. "Seeds," sterilised by various reagents, have been germinated in large tubes, on cotton-wool supplied with pure nutritive materials, and excellent plants thus raised out of contact with any but filtered air. Such pure cultures have been infected with uredo-spores, and the progeny utilized for similar re-infections, thus ensuring pure cultures of both host and parasite.

"Seeds," from infected plants, thus treated do not give rise to infected plants; and unless spores are sown on the leaves of the latter no pustules are developed. Moreover, pustules only arise in these cases on the spots where the spores were sown, and within the usual incubation period. These facts seem to militate against any theory of internal or intra-seminal sources of disease. It is hoped that by longer series of such pure cultures more definite information on several obscure points will be obtained.

At present the evidence points to the following conclusions. The acts of infection and incubation occupy about ten days, and many exigencies may prevent the germination of the spores, the entry of the germ-tubes into the stomata or the successful growth of the mycelium in the tissues.

Experiments go to show that the lack of certain minerals—*e.g.*, potassium or phosphates—cause a starvation of the Fungus; partial etiolation of the host, or any other hindrance to free nutrition, assimilation, transpiration, &c., also act detrimentally to the well-being of the mycelium.

Every degree of virulence of attack seems to be shown by the spores in the behaviour of their germ-tubes, either on different varieties or species of host, or on the same host in different conditions.

It appears that in certain cases the germ-tubes may kill the tissues, and cause them to turn black and shrivel up as if corroded. In such cases the parasite can make no further progress, and infection fails: In other cases a mycelium is developed, but lies dormant and produces no spores; we may compare the Fungus in this case to a plant in poor soil, or suffering from drought, &c.

Seedlings with "spears" only a millimetre or two high can be infected by applying spores to the "dew-drops" issuing from the water-stomata at the apex of the first leaf.

H. MARSHALL WARD.

CAMBRIDGE,
July 27, 1901.

OZONIUM AURICOMUM LINK.

By Charles B. Plowright, M.D.

This curious mycelial condition is familiar to all of us. Often to be found on chips in wood yards or between the bark and the wood of dead trunks, one seldom has the chance of seeing to what fungus it really belongs. Just as the familiar *Rhizomorpha* was for long recognised as a mycelial condition before its connection with *Agaricus melleus* was demonstrated, so there is a considerable amount of uncertainty about the true relationship of *Ozonium*. It is by no means impossible that all the *Ozonium*-like bodies one meets with are not connected with the same fungus. As is the case with *Rhizomorpha* the hyphæ of *Ozonium* are rather a condition of some fungal mycelium than the true vegetative mycelium, a condition in which the hyphæ are compacted into a sort of half felt half sclerotium. It is only under very favourable circumstances that one can observe the sporophore connected with them *in situ*. Having recently had the opportunity of observing the growth of a large mass of *Ozonium* and the development of sporophores connected with it a short account may not be uninteresting.

In a large earthen vase, some two feet in height, which was standing in the entrance hall of my house in King's Lynn, a flower pot containing a plant of Aspidistra was placed. Now, the vase was far too deep for the flower pot, so that the latter had to be raised from the bottom of the vase by placing it upon a block of wood, some six inches deep, as well as half an ordinary building brick. During the summer the Aspidistra was watered very freely, so that a considerable amount of water ran through the flower pot and collected in the bottom of the vase. It remains only to be added that the mouth of the vase was narrower than its body, so that the space between it and the top of the flower pot was only a narrow chink, and even this

was filled up for ornamental purposes by a frill of coloured paper.

In the months of September and October a succession of *Coprini* came up in the flower pot amongst the roots and between the stems of the Aspidistra. At first these attracted little notice, but after a time they were more carefully examined and proved to be *C. domesticus* Fr. Further investigation led to the flower pot being lifted out of the vase. It was found to be covered with the yellow hyphæ of *Ozonium*, as well as the brick and block of wood upon which it stood. The hyphæ were seen entering the opening at the bottom of the flower pot and the larger openings in the bottom and sides of the porous earthenware of which it was formed. These hyphæ had grown up through the mould until they reached the light and produced their sporophores on the surface as before described. The association of *Ozonium* with *Coprinus* had been observed in the spring of the same year. In West Briggs Wood, Wormegay, a decaying stick was found with a *Coprinus* on its upper side and a mass of *Ozonium* on its lower. No very careful examination was made at the time, so the species was not noted, and it may have been *C. domesticus*, but it is more likely that it was the frequently overlooked *C. similis* of Berkeley and Broome. It is probable that other mycologists have noted the association of *Ozonium* with *Coprinus*, but I have been unable to find any published account of their observations.

THE FUNGI OF GERMINATING FARM SEEDS.

By A. Lorrain Smith.

PLATE IX.

For the last two years I have been assisting in the botanical work undertaken for the members of the Royal Agricultural Society by the consulting botanist, and during that time I have had a great deal to do with testing the germination of grasses, clovers, and other farm seeds. If the seeds are slow in germinating or unsound, they are liable to be attacked by various fungi, and it has been interesting to note the constantly recurring moulds. The saucers on which the seeds are germinated are thoroughly cleansed by immersion in strong acid solution, and by subequent washing and scrubbing. It is impossible in such

work absolutely to preclude fungoid infection from the surrounding atmosphere during the progress of germination; but all ordinary means are employed to secure cleanliness and speedy growth of the seeds; and the evident conclusion is that the spores of most of the fungi that develop in the germination case have been brought into the laboratory with the samples. The rough pods of sainfoin carry most spores, and become very thickly covered with a rich mycelial growth. Smooth seeds, such as rye-grass and meadow fescue, germinate, as a rule, without showing any mould. It is, however, the quality of the seed that is the influencing factor. Fresh, healthy, well-filled samples germinate without any trace of fungi appearing; others, of the same kind but from a different sample, become mouldy in a few days. Unless the seeds have quite lost their vitality, the fungi do not really injure them or prevent the embryo sending out its rootlets, and clovers can grow when the outer coat is invisible owing to a thick crop of *Chætomium*.

My list of fungi is not exhaustive, as some forms, no doubt, have escaped observation; but a varied and interesting collection has already been made.

The higher fungi are not largely represented; there are no Basidiomycetes; and, as yet, only three Ascomycetes have been noted. Two of these belong to *Chætomium*, a genus of Pyrenomycetes. They are saprophytic and superficial on whatever substance they grow. *Chætomium Kunzeanum* Zopf, which is perhaps the most frequently met with, has a small elliptical fruit crowned at the summit by a bristly head of olive-brown hairs, which are unbranched, wavy, and somewhat rough when mature. *C. elatum* Kunze, which occurs also very frequently on the same kinds of seeds, is darker in colour, and the hairs of the crown are branched and very rough from the beginning. The ascospores of both species are a dull olive-brown. They grow on decaying vegetation, *C. elatum* more especially on grass. In the germination case they grow on grasses and clovers, and occasionally on turnip seeds. There is no doubt that towards the end of each season, the laboratory must be well furnished with *Chætomium* spores, and that may doubtless account for some of the infection. I have germinated some of the ascospores on a gelatine plate, and have obtained a beautiful growth of the *Oidium*-like conidial form, a creeping mycelium with upright conidiophores bearing a terminal chain of conidia, but I have never detected any conidial growth on the seeds.

The remaining Ascomycete, *Gymnoascus Reesii* Baran., I found on carrot and on turnip seed. It usually grows on decaying organic substances such as dung, and it is easy to understand how the spores might be blown by the wind on to the ripening

seeds. *Gymnoascus* is one of the less highly organised Ascomycetes, the peridium is composed of loose much-branched yellowish hyphæ, which surround the fertile filaments. When mature, the walls of the small globose asci disappear, but the minute spores retain for a time the form of the ascus. The fungus was attached loosely to the spines of the carrot seed, and seemed to have little organic connection with it; in this resembling the *Chætomiums*, which often grow on the awns of the grasses. Many of the smaller fungi grow with very little nutrition; those I have been watching often spread from the seeds to the germinating saucer, and grow vigorously on the porcelain, apparently on nothing, though doubtless some seed had lain on the spot and left some of its substance behind.

The Hyphomycetes bulk very largely in this flora of seed-fungi. The two ubiquitous species *Aspergillus glaucus* Link, and *Penicillium glaucum* Link, appear continually. *Cephalosporium Acremonium* Corda, *Sporotrichum laxum* Nees, and *Acremonium alternatum* Link, are not infrequent. These all grow on decaying vegetation, and are very common moulds. *Trichoderma viride* Pers., the conidial form of *Hypocrea rufa*, I have found several times, and have cultivated it on a gelatine slide; there was a beautiful growth in three days of upright branching colourless conidiophores bearing the groups of bright green spores at the tips of the branches. A form of *Sepedonium*, plate IX. fig. 1, entirely colourless, formed a white tuft on a grass seed. The spores, which are borne at the tips of delicate hyphæ, are globose and rather large, measuring about 18-20μ in diameter. They have a thick epispore, and are warted when mature. It agrees with the characters given of the species *S. xylogenum* Sacc., which has been found in Italy growing on wood. I have also to record in the Mucedineæ a specimen of *Botrytis vera* Fr., distinguished from other members of the genus by the lax branching of the sporophores. It grew on turnip seed.

Among the Dematieæ, *Macrosporium commune* Rabenh., the conidial form of *Pleospora herbarum*, occurs most frequently. *Helminthosporium gramineum* Rabenh. I have detected once on a grass seed. It is a parasite of cereals, destroying the leaves and so weakening the plant and injuring the grain. Some barley affected by it was sent into the laboratory during the summer of 1900. I have one record of *Stachybotrys alternans* Bonord. It is a fairly common mould, and grows by preference on damp blotting paper. *Stysanus stemonites* Corda, one of the Stilbeæ, by no means a rare fungus, has occurred several times on grass seeds.

Fusarium roseum Link, which formed its delicate rose-tinted cushions on clover seed, is a member of the Tuberculariеæ. In

a culture I made, it grew in a very straggling fashion, and budded off a succession of spores from the tips of the branches. It has been recorded on decaying leaves and stems. Another species, *F. commutatum* Sacc. (plate IX. fig. 2), is new to this country; it falls under Saccardo's group "*sporodochia laxa, effusa, byssina.*" On clover seed it hardly looked like a *Fusarium*, but on a culture plate it formed lax cushions; the spores are three-septate and measure 20—25 × 4—5μ. There is one difference between this species and the type in that the sporophores are septate, otherwise Bonorden's drawing exactly represents the habit of the fungus, and "*sporophoris continuis*" may not be a constant character.

There are two forms of Hyphomycetes that have puzzled me a good deal. The first grew on a seed of *Festuca pratensis* and from the character of the hyphæ and spores I have placed it in the hitherto monotypic genus *Langloisula* of Ellis and Everhart. The hyphæ are much larger, the spores also are larger, more deeply coloured, and not so pear-shaped as in the American species, *L. spinosa*. I therefore consider it to be a distinct species, and have named it *L. macrospora* (plate IX. fig. 3). I fear the genus, however, rests on too narrow a foundation of divergence from other forms, and the species might have been included in *Acremoniella*. The other specimen has baffled all my attempts to place it under any recorded genus. It is in form and habit something like a *Stemphylium*, and, but for lack of colour, I would have classed it under that genus. There is only one genus recorded under the group Mucedineæ-hyalodictyeæ, and it is entirely different in form from the fungus I have been dealing with. I have been compelled to establish a new genus, which I have named *Stemphyliopsis* g. n., to connect it with its nearest ally among the Dematieæ the species I have called *heterospora*, plate IX. fig. 4. The spores are exceedingly varied in form and size, and are borne at the tips of short branches from the main hyphæ. They are warted when mature, and the whole plant remains colourless after some weeks' culture. I succeeded in reproducing it on a gelatine plate. I got the original specimens on turnip seed and on clover seed.

The Mucorineæ are the sole representatives of the Phycomycetes that have appeared in the germinating case, and *Rhizopus nigricans* Ehrenb. most frequently of all. It grows on any kind of seed, though on the whole it is partial to the grasses. It spreads very quickly, and in time extends over the whole available space. I have found another form also with rootlets somewhat similar to those of *Rhizopus*, which on that account I have included in the same genus. The sporangiophores rise singly from the runner-like hyphæ, and near the top they form

an umbel of four short branchlets, each of which is terminated by a subglobose smooth sporangium. The tip of the branchlet expands gradually into the subglobose columella, to the base of which part of the sporangium wall remains attached after the dispersal of the spores. The whole plant is entirely colourless; the spores are small, oblong, and blunt at the ends. From the mode of branching I have named it *Rhizopus umbellatus* (plate IX. fig. 5). In one instance I found the main sporangiophore terminate in a sporangium with one side branchlet imperfectly developed; all the other examples have the umbellate head of branches. I have only found it once on clover seed, associated with another *Mucor*. It is entirely microscopic, and I have not succeeded in cultivating it. The *Mucor* in which it was entangled, if indeed it was not parasitic on it, I have determined to be *Mucor erectus* Bain. (plate IX. fig. 6). It forms delicate silky white tufts 2 or 3 centimetres in length. The hyphæ branch frequently, and the very unequal branches terminate in a small yellowish sporangium. A distinctive feature of this species is the septum that is always present just above the point where the branch is given off. I found it on turnip and carrot seeds, and I got a further abundant growth on a mixture of gelatine and bean decoction. *Mucor erectus* has been found in Europe on bread, plum decoction, and potatoes, but this is the first record for Britain. I have not yet been able to induce the growth of zygospores. *M. racemosus* Fres. (plate IX. fig. 7) appeared on clover seeds. It is easily recognisable from the chlamydospores which are produced in great abundance on the hyphæ and sporangiophores. I hardly think it is new to this country, but I cannot find any published record of its occurrence. It grows on a great variety of substances, and is very common on the Continent.

EXPLANATION OF PLATE IX.*

Fig. 1.—*Sepedonium xylogenum* Sacc. *a*, branches with developing spores from a culture × 500. *b*, mature spores × 500.

,, 2.—*Fusarium commutatum* Sacc. *a*, sporophores with developing spores × 90. *b*, mature spores × 500.

,, 3.—*Langloisula macrospora* sp. n. Fertile branches and spores × 500.

,, 4.—*Stemphyliopsis heterospora* g. et sp. n. Fertile hyphæ and spores × 500.

,, 5.—*Rhizopus umbellatus* sp. n. *a*, sporangiophore with columellae × 90. *b*, sporangium × 250. *c*, rootlets × 250. *d*, spores × 500.

,, 6.—*Mucor erectus* Bain. *a*, sporangiophore × 250. *b*, columella × 500, spores × 500.

,, 7.—*Mucor racemosus* Fres. *a*, hyphæ with chlamydospores × 250. *b*, sporangium with spores × 250. *c*, empty sporangium × 250. *d*, spores × 500.

,, 8.—*Mucor spinosus* Van Tiegh. *a*, branching sporangiophore × 90. *b*, columella and spores × 500.

,, 9.—*Sphæronemella oxyspora* Sacc. *a*, pycnidia × 35. *b*, sporophores and spores × 500.

*(By kind permission of the Royal Microscopical Society).

A.L.S. del. Highley lith.

Hanhart imp.

SPORE-FORMATION IN SACCHAROMYCETES.

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In 1883 Hansen (1) published the results of his experiments on the conditions necessary for the formation of spores in the *Saccharomycetes*. They were as follows:—

1. The cells must be placed on a moist surface and have a plentiful supply of air.
2. Only young, vigorous cells can exercise this function.
3. The formation only proceeds between certain temperature limits, the limits varying for different species. The most favourable temperature for most species is about 25° C.

Previously little was known concerning the necessary conditions, and since that time Hansen's results have been generally accepted, until last year, when Klebs (2) suggested that the real condition had been overlooked by Hansen, viz.:—The want of food, or, to put it more particularly, the sudden change from very favourable nutritive conditions to a state, more or less, of starvation. Recently another element has also entered into the question. Three species, viz.:—*Saccharomyces octosporus*, *S. Pombe*, and *Zygosaccharomyces*—require a process of conjugation and nuclear fusion before spores are formed, with the exception of a few isolated cases in *S. octosporus*. Janssens and Leblanc (3), in their work on the yeast nucleus also have stated that *S. cerevisiae* and other allied species require nuclear fusion before fertile spores can be produced.

The following experiments have been undertaken with a view of testing these statements, and can be divided into two groups, viz.:—

I. Those in which the effect of external conditions is studied.

II. Those dealing with the conditions of the cells themselves, *i.e.*, internal conditions.

I. In all the following experiments, except where otherwise stated, the method of testing the capability of the cells to form spores under any given set of conditions consisted in pouring a few drops of beer-wort, containing actively-growing yeast cells upon a square block of Plaster of Paris, about an inch thick, contained in a covered glass dish. This was moistened with distilled water and placed at 25° C. The yeast cells were obtained in an active condition by infecting a tube of beer-wort,

allowing it to stand for 24 hours at 25° C, and then infecting a fresh tube from it, which was also kept for 24 hours at 25° C. *Saccharomyces cerevisiae* Hans. and *S. anomalus* Hans. were the species used.

The first set of experiments consisted in testing the effect of the porosity of the block upon which the spore-culture is made, it being suggested by Klebs that the function of the Plaster of Paris block was to serve as a means to separate the food materials from the cells. Obviously, then, the more porous the material the better separation there would be.

The substances used were Plaster of Paris, a pad of filter paper, porous porcelain of two kinds, cardboard, and pieces of a plant pot. These are arranged in the order of their porosities, the first two being equally porous. These were placed in separate covered glass dishes, and were moistened with a few drops of distilled water after the beer-wort had been soaked up. The vegetation on them was examined after 48 hours in the series, where *S. cerevisiae* was the species used ; and it was found that the number of spores produced varied according to the porosity of the material. Arranging the materials in the order of the number of spores formed thereon, the arrangement corresponds exactly to that given above as representing the porosities of the materials.

A similar experiment was made, using *S. anomalus* Hans. in the place of *S. cerevisiae.* The vegetation in this case was examined after 72 hours, a longer time being required for the formation of spores in this species. The results here corresponded exactly to those in the preceding case.

At first sight these results seem to support Klebs' view, but it must be borne in mind that not only does better porosity imply better separation of food material, but also better æration. In the case of a poorly porous substratum, the cells are immersed in comparatively large drops of liquid, while a very porous substratum leaves the cells practically exposed to the air, being kept moist by the large amount of aqueous vapour rather than a film of liquid.

An attempt was then made to estimate the effects of the presence or absence of nutrient substances. Five sets of spore-cultures were made :—

a. In which the blocks were kept moist with fresh beer-wort.

b. In which the blocks were kept moist with a mixture of 25 per cent. fresh beer-wort and 75 per cent. distilled water.

c. In which the blocks were kept moist with a mixture of 10 per cent. beer-wort and 90 per cent. distilled water.

d. In which the blocks were kept moist with distilled water only.

e. In which the blocks were suspended in large beakers of distilled water, the surfaces of the blocks on which the yeast cells were situated being kept above the level of the liquid.

In *d* the only food material present was that contained in the few drops of beer-wort poured over the gypsum block, and in which the yeast cells had been actively growing for 24 hours.

In *e* a similar amount would be present at the start of the experiment, but by diffusion into the large quantity of distilled water contained in the beaker the cells would be practically denuded of all nourishment.

With *S. cerevisiae* an abundant supply of spores was obtained in *d* and *e*; in *c* the number was fair; in *b* moderate; and in *a* none were formed. The number of spores produced for this species, then, was inversely proportional to the amount of food material present.

In the case of *S. anomalus*, however, an opposite result was obtained. No spores were formed in *e*, while *d*, *c*, *b*, and *a* formed an increasing series. The number of spores in this case, then, was directly proportional to the amount of food material present.

These results correspond well with certain facts that have already been observed in different cultures of the two species. *S. cerevisiae* forms no spores in streak cultures on various nutrient gelatine or agar media, nor in nutrient solutions. *S. anomalus*, on the other hand, forms spores abundantly in streak cultures on beer-wort gelatine, or agar, and also in solutions of various sugars.

Klebs' view, then, cannot hold for *S. anomalus*. It has been suggested that the variations in osmotic pressure might have something to do with these results. A series of cultures was therefore made, in which the gypsum blocks were moistened with solutions of KNO_3 (also NaCl) of different strengths. The solutions of KNO_3 and NaCl were of the following strengths:—

a.	10	grams KNO_3	to 100 c.c. of water.
b.	5	grams KNO_3	,,
c.	2·5	grams KNO_3	,,
d.	1·25	grams KNO_3	,,
e.	5	grams NaCl	,,
f.	2·5	grams NaCl	,,
g.	1·25	grams NaCl	,,
h.	·65	grams NaCl	,,

and control blocks moistened with distilled water in the case

of *S. cerevisiae* and with fresh beer-wort in the case of *S. anomalus* were also prepared.

For *S. cerevisiae*, *b*, *c*, *d*, *f*, *g*, and *h* showed as good a spore yield as the control blocks, while *a* and *e* gave a less abundant spore formation. Hence for this species comparatively great osmotic pressure variations had no effect on the spore formation, and it was only in the case of very large alterations that the yield was materially affected.

For *S. anomalus* spores were only produced on the control blocks. This points to the fact that for this species the presence of food is a necessary condition, while variations of the osmotic pressure have little or no effect within moderate limits, since spores are formed when the blocks are kept moist with beer-wort of different strengths.

Variations in the æration of the cells were then tried. Cultures were placed in (*a*) an atmosphere of pure CO_2, (*b*) air containing considerably more CO_2 than normal, (*c*) ordinary air, (*d*) air freed from CO_2 by potash. *S. cerevisiae* and *S. anomalus* gave corresponding results. No spores were produced in *a* or *b*. In *c* there was a good spore yield, and in *d* an even better yield. The blocks used for the culture of *S. anomalus* were moistened with fresh beer-wort instead of distilled water. The æration, therefore, has a direct effect on the spore-production, the presence of CO_2 tending to inhibit it.

The effect of moisture apparently varies according to the different conditions under which the experiment is conducted. Four cultures on gypsum blocks were placed as follows:—

a. In air kept dry by calcium chloride. No moisture added beyond that supplied by the few drops of beer-wort, which served as the source of the cells.

b. In ordinary air. Moisture added as in *a*.

c. In air. Blocks kept moist by addition of small quantity of distilled water.

d. In air. Blocks standing in distilled water.

The results for *S. cerevisiae* showed that *b*, *c*, and *d* gave very good yields of spores, but none were produced in *a*, the cells having dried up. The results for *c* and *d* hold good in those cases where the surface of the block is kept nicely moist without, however, becoming sloppy. Some gypsum blocks, on the addition of liquid, crumble somewhat and in cases the surface exposed to the air becomes pasty and the block is therefore rendered much less porous, and in extreme cases the beer-wort is never properly soaked up. Naturally, also, the æration of the cells on such blocks is very poor; and, as one would

expect from the preceding results, the yield of spores is very small and often nothing. In all experiments in which the blocks behaved in this fashion, the blocks were rejected.

Summing up the results thus obtained, we find that for *S. cerevisiae*—

1. The yield of spores is directly proportional to the porosity of the material used for the culture block.
2. The yield of spores is inversely proportional to the amount of food material present.
3. Large quantities of CO_2 inhibit the spore formation; and the less the amount of CO_2 present the better the yield.
4. Variations in osmotic pressure up to the amount exerted by 5 per cent. KNO_3 solution do not affect the yield. Ten per cent. potassium nitrate solution retards spore formation.
5. The amount of moisture present does not affect the yield unless the æration of the cells is too greatly interfered with.

For *S. anomalus* the conclusions are similar with the exception of 2. In this case the yield of spores is directly proportional to the amount of food material present.

The results, on the whole, support Hansen's view that good æration is necessary for spore formation. This seems to be the necessary condition in all cases for both species. Klebs' view apparently receives support by the behaviour of *S. cerevisiae.* But may it not be that for this and other vigorously fermenting species, when fermentable sugars are present in any considerable quantity, a large amount of CO_2 is produced, and that the presence of this gas serves to inhibit the spore formation? At any rate, Klebs' view cannot hold good for *S. anomalus*, and it is quite possible that the numerous other species which also form spores on various nutrient media may behave in the same way as this species.

II. *The influence of internal conditions on spore formation.*

a. The cells must be in a vigorous state of growth. This is effected by twice successively cultivating the cells in fresh beer-wort for 24 hours at 25° C. The necessity of this condition is easily proved by making spore cultures with cells of *S. cerevisiae* 24 hours, 48 hours, 72 hours, &c. old. The only case in which an abundant spore yield is obtained is when cells 24 hours old are used. Few spores are formed in other

cases, and none, as a rule, where the cells are more than 48 hours old.

b. Possibly a sexual process is necessary. *(See Note.)*

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2. *Klebs.* Zur Physiologie der Fortpfl, einiger Pilze. Prings. Jahrb. XXXV.

3. *Janssens and Leblanc.* Recherches cytologiques sur la cellule de Levure. La Cellule. T XIV. Fasc. 1, pp. 203-243.

NOTE.—An account of the sexual process, occurring in certain Yeasts, has recently been published. (*Barker.* Sexual Spore-Formation in Yeasts. Ann. Bot. Dec. 1901.) A short discussion of the question of the sexuality of the Saccharomycetes in general will be found in that paper.

FUNGI NEW TO BRITAIN.*

By Annie Lorrain Smith, &c.

Mucor erectus Bain. Ann. Sci. Nat. Ser. 6, Vol. 19, p. 207.

Sporangiophores upright, somewhat flaccid, forming silky tufts up to 1 c.m. or more high, much branched, the branches varying in length, septate just above the insertion of each branch; sporangia terminal on the main stem and branches, small, globose up to 120μ in diameter, somewhat yellowish, transparent, smooth; columella globose, usually about 40μ in diameter; spores elliptical, varying in size, mostly flat on one side, 5-10μ × 2·5-5μ, colourless, shewing dark in the mass; zygospores globose, 40-65μ in diameter, the exospore yellowish or reddish-brown, with darker, star-like, flat markings; azygospores similar to the zygospores; gemmae varying in form, finely spinous, colourless.

On bread, decaying potatoes, &c. Found on farm-seeds that were being tested for germination. Norwood, June, 1901. Pl. ix., fig. 6.

* Owing to lack of space it has been impossible to reprint the descriptions of species that have already been published in this country other than those on Plate IX. The student is referred to the Journals quoted in this list for a complete account of the fungi new to science or new to Britain.

M. spinosus Van Tiegh. Ann. Sci. Nat., Ser. 6, Vol. 4, p. 390.

Sporangiophores upright, stiff, up to 1 c.m. high, branched, septate above the insertion of the branches; sporangia terminal on the main stem and branches, small, globose, about 100μ in diameter, at first colourless, becoming dark-brown or black, covered with delicate spines; sporangium wall disappearing, leaving a basal collar; columella cylindrical or pyriform, with one or more short, irregular outgrowths at the top; spores globose, 5-9μ in diameter, greyish-brown, smooth; zygospores globose, yellowish-brown, the exospore with dark, irregular, lamelliform markings that rise to a point; gemmae formed in the hyphæ.

On horse dung, vegetable refuse, &c. Found on a leaf of a cherry tree from Kent, July, 1901. The spores were not smooth as given in Van Tieghem's diagnosis, they were finely echinulate. In other respects the specimen agreed with the description of the type. Pl. ix., fig. 8.

M. racemosus Fres. Beitr. z. Mycol., p. 12.

Sporangiophores upright, stiff, varying in height, forming brownish-yellow patches, irregularly much branched; sporangia globose, small, varying in size, 20-70μ in diameter, somewhat yellowish, transparent, sporangium wall persistent, with small incrustations of lime, and a short basal collar; columella broadly clavate, varying in size, 17-60μ long, 7-30μ broad at the base, 9-42μ above, sometimes globose, spores globose, or shortly elliptical or angular, 5-8μ × 6-10μ, smooth, yellowish in the mass; zygospores globose, 70-85μ in diameter, brownish, the exospore beset with reddish-brown, bluntly conical warts; gemmae or chlamydospores always in great abundance in every part of the hyphæ, colourless or yellowish, smooth, very variable in form, 11-20μ × 20-30μ or globose, 20μ in diameter.

On all decaying matter. Found on farm-seeds. Norwood, June, 1901. Pl. ix., fig. 7.

Rhizopus umbellatus A. L. Sm. Pl. ix., fig. 5.

Spreading hyphæ with sucker-like roots, delicate, about 8-10μ in width; sporangiophores rising singly from the runner-like hyphæ up to 500μ in length, and branching above in an umbellate manner; secondary branches usually four, sometimes septate, slightly wider at the top, and terminated by a subglobose sporangium 50 × 60μ; sporangium-wall delicate, attached to the base of the columella; columella globose, 30μ in diameter; spores minute, oblong, blunt, 5 × 2μ. The whole plant colourless.

On a seed of red clover in the germinating case, entangled with Mucor erectus. Norwood, June, 1901.

Monilia Glasti Plowr. Journ. Bot. 1901, Vol. 39, p. 385.

On woad balls, Parson Drove Woad Mill, Cambridgeshire.

Sterigmatocystis nigra Van Tiegh.

On stale bread, Kew. Mr. E. S. Salmon in Quekett Micr. Journ., Ser. 2, Vol. 7, p. 373. Pl. 20, figs. 8-10.

Sepedonium xylogenum Sacc. Mich. ii., p. 552. F. ital. t. 715.

Tufts effused, white, subpulverulent, hyphæ filiform, obsoletely septate; fertile branches, simple or furcate, conidia acrogenous, globose, asperulate, colourless, 15-18μ in diameter.

On dead wood. Found on farm-seeds. Norwood. Pl. ix., fig. 1.

Fusarium commutatum Sacc. Syl. iv., p. 710.

Tufts broadly effused, white, floccose; conidiophores irregularly branched; conidia at first somewhat globose, then fusiform, 3-septate, 20-25 × 5μ, slightly curved, colourless.

On potatoes. Found on germinating farm-seeds. Pl. ix., fig. 2.

Langloisula macrospora A. L. Sm. Pl. ix., fig. 3.

Fungus consisting of entangled, much-branched, septate hyphæ, 5-8μ in width, the branches varying much in length from 12-40μ, tapering to a sharp point, colourless, bearing a single spore, at the tip; spores brown, ovate, with a thick epispore, slightly pointed towards the base, where there is a small clear spot, warted when mature, 25-30 × 15-20μ.

On a grass seed in the germinating case. Norwood.

Stemphyliopsis A. L. Sm.

Hyphæ intricately branched, colourless, septate; spores terminal on the branches, elliptical or subglobose, 2-many-septate and muriform, colourless.

S. heterospora A. L. Sm. Pl. ix., fig. 4.

Growing in tufts up to 2 mm. in height, consisting of a tangled mass of colourless rather delicate hyphæ with numerous short branchlets; spores varying in form and size, elliptical, from 12 × 8μ up to 25 × 15μ or subglobose about 15 × 12μ, transversely septate and 2 or more-celled or cruciate and muriform, colourless, warted when mature.

On clover and turnip seed in the germinating case. Norwood.

Helminthosporium obclavatum Sacc. Mich i. p. 85, F. ital. t. 52.

Effused, forming large black spots; hyphæ erect, filiform subincrassate at the base, 60-70μ × 6-7, with few septa, fuliginous brown;

conidia acrogenous, solitary, obclavate-fusiform, gradually attenuate upwards, about 90 × 15, round at apex, base wedge-shaped, truncate, 18-24-septate, dark brown.

On decaying wood. Exeter, September, 1901.

Stilbum leiopus Ehren.

Stalk stout, smooth, white, gradually tapering to a subglobose depressed, rose-coloured head, the whole fungus having a somewhat clavate appearance.

Found by Mr. Hey on the dung of the wood mouse, Scabba wood, Yorkshire. The Naturalist, November, 1901, p. 342.

Endomyces Reess, Bot Unters. ueb. Alkoholgähr, p. 77.

Mycelium creeping, much branched, mostly parasitic, asci solitary on the ends of short, simple side branches, globose or pyriform, 4-spored, spores one-celled.

E. coprophilus Mass. and Salm. Ann. of Bot., Vol. 15, p. 324. Pl. xvii., fig. 35.

On horse dung, Kew.

Myxotrichum uncinatum Schröet.

On rabbit dung, Kew. Mass and Salm. loc. cit., p. 325. Pl. xvii., figs. 30-32.

Cenangium Sarothamni Fuckl. Sym. Myc. p. 270.

On dry branches of *Sarothamnus scoparius*, Scarborough, Yorkshire. G. Massee. The Naturalist, June 1901, p. 178.

Thelebolus stercoreus Zukal (sic.)

On rabbit dung. Mass and Salm. loc. cit., p. 326. Figs. 41-44, 66. The authors are evidently dealing with the fungus already recorded in these Transactions p. 115 under *T. nanus*. The plant *Thelebolus stercoreus* was originally named and described by Tode. Messrs. Massee and Salmon, following Continental Fungologists, have ignored the original author and his description of *T. stercoreus* which was a fairly large plant, the size of a poppy seed. The plants found at Reigate and Kew did not exceed 240μ in diameter.

Ryparobius ascophanoides Sacc.

On rabbit dung, Kew. Mass. and Salm. loc. cit., p. 327. Figs. 33, 34.

Ascobolus perplexans Mass. and Salm. loc. cit., p. 328. Figs. 52-55.

On dung of elephant, red-deer, horse etc., from London and neighbourhood.

Saccobolus quadrisporus Mass. and Salm. loc. cit. p. 329. Figs. 48-51.
On dung of ass, Kew.

Mollisia nervicola Gill.
On under surface of decaying oak leaves; mostly on the nerves. Hebden Bridge, J. Needham. Naturalist, June 1901, p. 180.

Belonidium Clarkei Mass. and Crossl. Naturalist, June, 1901, p. 181, pl. i., figs. 1-6.
On damp rotten wood. Whitby, September, 1900. A. Clarke.

Lachnea contorta Mass. and Crossl. Naturalist, June, 1901, p. 182, pl. i., figs. 7-11.
On naked ground. Selby, Yorkshire. G. Massee.

L. Lojkaeana Rehm.
On the ground, Hebden Bridge, Yorkshire. Naturalist, June, 1901, p. 183.

Dasyscypha inquilina Wint.
On *Equisetum sylvaticum*, Hebden Bridge. J. Needham. Naturalist, June, 1901, p. 183.

D. vitreola (Karst.) Mass. Naturalist, June, 1901, p. 183. Pl. ii., figs. 12-16.
On dead Blackberry stems. Kew. G. Nicholson.

Humaria carneola Wint.
Growing on living moss, Sutherlandshire. Mr. E. S. Salmon, Quekett Micr. Journ., Ser. 2, Vol. 7, p. 373. Pl. xx., figs. 4-7.

H. Nicholsonii Mass. Naturalist, June, 1901, p. 188. Pl. ii., figs. 17-21.
On dead Beech leaves. Kew. G. Nicholson.

Mitrophora rimosipes Lév.
On the ground. Edith Weston, Rutland. Miss Crowther-Baynon. Naturalist, June, 1901, p. 189.

Microsphæra Bäumleri P Magn.
On *Vicia sylvatica*. New Pitsligo, Scotland. Mr. E. S. Salmon, Quekett Micr. Journ., Ser. 2, Vol. 7, p. 371. Pl. xx., figs. 1-3.

Pleuroascus Nicholsoni Mass. and Salm. (g. et sp. nov.) Ann. of Bot., Vol. 15, p. 330. Pl. xvii., fig. 25.
On dung of guinea pig. Kew, January, 1901. Coll. Geo. Nicholson.

Eurotium insigne Wint.

On dung of kangaroo, horse, &c. Mass. and Salm. loc. cit., p. 331. Figs. 29, 39-40.

E. microsporum Mass. and Salm. loc. cit., p. 333. Fig. 28.

On dung of guinea pig, goat, sheep, &c.

Magnusia Sacc. Mich. 1, p. 123.

Perithecia superficial, at first globose, then horizontally elliptical or angular, without an ostiole, black, at each end or corner provided with a strand of 2-6 long, brown appendages; asci pyriform, evanescent, 8-spored; spores elliptical, 1-celled, brown; no paraphyses.

M. Bartlettii Mass. and Salm. loc. cit., p. 333. Fig. 26.

On dung of guinea pig, wild sheep, &c.

Sphæroderma fimbriatum Rostr.

On dung of guinea pig. Kew. Mass. and Salm. loc. cit., p. 351. Fig. 23.

S. Hulseboschii Oud.

On rabbit dung. Leith Hill, Surrey. Mass. and Salm. loc. cit., p. 352. Figs. 57-61.

Melanospora discospora Mass. and Salm. loc. cit., p. 352. Figs. 36-38.

On dung of ibex and wild sheep. Kew.

Sordaria globosa Mass. and Salm. loc. cit., p. 334. Fig. 21.

On dung of kangaroo and red deer. Kew.

S. anserina Wint.

On goose dung. Kew. On dung of kangaroo and giraffe. Loc. cit., p. 334. Fig. 6.

S. minima Sacc. and Speg.

On dung of rabbit and hare. Kew. Loc. cit., p. 335. Fig. 11.

S. hirta Hans.

On cow dung. Kew. Loc. cit., p. 336. Fig. 7.

S. setosa Wint.

On dung of rabbit, deer, sheep, &c. Loc. cit., p. 336. Fig. 13.

S. curvicolla Wint.
On rabbit dung. Kew. Loc. cit., p. 337. Fig. 12.

S. pleiospora Wint. Bucknall, No. 825.
On dung of giraffe. Kew. Loc. cit., p. 338. Fig. 14.

S. macrospora Auersw.
On dung of hare and kangaroo. Kew. Loc. cit., p. 339. Fig. 9.

S. neglecta Hans.
On cow dung. Reigate. Loc. cit., p. 339. Fig. 15.

S. Winteri Karst.
On horse dung. Kew. Loc. cit., p. 340. Fig. 5.

S. fimiseda Ces and de Not., var *appendiculata* (Auersw.)
On dung of Mexican deer. Kew. Loc. cit., p. 340. Fig. 16.

Delitschia moravica Niessl.
On rabbit dung. Reigate. Loc. cit., p. 343. Fig. 18.

D. insignis Mout.
On horse dung. Epping Forest and Kew. Loc. cit., p. 344. Fig. 20.

Sporormia longipes Mass. and Salm., loc. cit., p. 346. Fig. 1.
On dung of deer, goat, &c. Kew.

S. ovina Sacc.
On rabbit dung. Kew. Loc. cit., p. 346. Fig. 4.

S. pulchella. Hans.
On horse dung. Kew. Loc. cit., p. 347. Fig. 2.

S. fimetaria de Not.
On cow dung. Aboyne, Scotland. Loc. cit., p. 347. Fig. 19.

Microascus Zukal Ueb. eine neue Pilze, Myx. and Bakt., p. 9.

Perithecia globose, ostiolate, carbonaceous, smooth or covered with stiff hairs; asci spherical, 8-spored, formed from the swollen ends of hyphal branches, evanescent; spores unequal-sided, elliptical or lunate, brown or reddish-brown, smooth.

M. variabilis Mass. and Salm. loc. cit., p. 349. Fig. 24.

On dung of Patagonian cavy. Kew.

M. nidicola Mass. and Salm. loc. cit., p. 350. Figs. 62-65.

On an old nest of a wild bee along with *Myxotrichum setosum* and *Arachniotus candidus*. (These two latter fungi are also new to the British flora).

Spumatoria longicollis Mass. and Salm. (g. et sp. nov.) loc. cit., p. 350. Fig. 27.

On horse dung. Epping Forest.

Poronia leporina Ellis and Everh.

Stipitate, flesh coloured, small, stipe 1-2 mm. long, $\frac{1}{2}$ mm. thick, expanding above into a discoid stroma 1-2 mm. in diameter, and mammillose from the slightly prominent perithecia which are ovate-globose, about $\frac{1}{2}$ mm. in diameter, 6-20 in a stroma; ostiola large, black, convex; asci clavate-cylindrical, 80-100 (*p. sp.* 75-80) × 10-12μ, with obscure paraphyses; spores at first greenish-hyaline, becoming opaque, subinequilaterally elliptical, mostly uniseriate, 12-15 × 6-7μ.

On rabbit dung. Cadeby, Yorkshire. Naturalist, November, 1901, p. 341.

Sphæronemella oxyspora (Berk.) Sacc.

Perithecia minute, subulate, straw-coloured, glistening; spores elliptical, appendiculate at both ends up to 7μ × 2μ, appendages 3μ in length.

On a dead agaric. Llanymawddwy, N. Wales. Pl. ix., fig. 9.

Thelephora vitellina Plowr.*

Pileus pale egg-colour, flabelliform, expanded upwards, superior margin rimose, slightly incurved laterally. Hymenium rugulose, zoneless. Stem attenuated downwards, but enlarged at the base. Pileus $\frac{1}{4}$-$\frac{1}{2}$ or $\frac{3}{4}$ in. across (10-18 mm.), 1-1$\frac{1}{2}$ in. (20-30 mm.) high, spores oval, 3 × 1-1·5μ.

On a dead fir branch amongst moss, and in the interior of a fir tree. Boat of Garten, September, 1900. Mr. Scott Elliot and Mr. Angus Grant, 1901.

Specimens were sent to M. Boudier, who pointed out its resemblance to *T. sowerbei* B. and Br., from which it differs in its pure yellow colour and lignicolous habit, as well as in the small size of its spores.

Polyporus (Fomes) Euonymus Kalch.

On the base of the stem of *Euonymus Europæus* near Salisbury.

* See p. 119 and 123.

Mr. E. J. Tatum, 1899. Dr. C. B. Plowright in Journ. Bot., Vol. 39, p. 385.

Agaricus perrarus Schulzer. Bres. Fung. Trid., p. 82, pl. 89.

Pileus 6-14 cm. and more broad, fleshy, campanulate, then expanded, yellow, covered with dense imbricate Lepiota-like fulvous scales. Stem 9-11 cm. long by 1½ to 3 cm. thick, incrassated at the base, whitish, covered below the ring with evanescent fulvous scales, floccosely stuffed, then hollow. Ring white, becoming discoloured, large, superior and reflexed. Flesh white, soft, that of the stem turning yellowish when sectioned. Gills crowded, free, and often very remote, equally attenuated at both ends, 5 mm. broad, white, then rosy, and finally fuscous. Spores obovate, purplish fuscous, 7-9 × 4-5μ.

Amongst grass under an oak. Claines, Worcestershire, 26th August, 1901. Mr. Carleton Rea.

Polyporus flavo-virens B. and Rav.* Centur. N. Amer. Fungi, n. 43.

Pileus 8-10 cm. broad, soft, pulvinate or depressed, irregularly lobed, subtomentose, dirty yellowish-green, flesh white, stem 5 cm. long by 2-3 cm. thick, incrassated upwards, pallid, of the same colour as the pileus. Pores ½ mm. deep, very decurrent, angular, very irregular and with thin dissepiments, finally torn, at first white, then yellowish-green; spores spindle-shaped, dirty green, 15-18 × 7-8μ.

Under Pinus sylvestris. Boat of Garten, Invernessshire, 21st September, 1900. Rev. D. Paul, LL.D.

Femsjonia Summ. Veg. Scand., p. 341.

Cup-shaped, distended with firm jelly, different on the two sides, disc thick, heterogeneous, even and not glandular. Sporophores immersed, globose, the oblong spores curved.

Growing on wood, erumpent, brightly coloured.

Femsjonia luteoalba Fr. Hym. Eur., p. 695.

Cup 2-13 mm. across at first convex, then plain, bright golden yellow, externally white and mealy, rooting and erumpent. Spores 12-22 × 7-8μ, boat-shaped, multiseptate at maturity. Basidia 75-80μ, with two long sterigmata, 35-40μ.

On birch and oak. Newton Saint Cyres, Devon, 25th and 27th September, 1901. Dr. C. B. Plowright.

"This fungus is probably far from rare, but has hitherto been overlooked in this country, owing to the fact that it retains its cup-like form only during the earlier stages of its existence. During the

* This species was doubtfully referred at p. 120 and 122 to Gyrodon?

Fungus Meeting of the Cryptogamic Society of Scotland held at Edinburgh in October, 1878, in the excursion to Penicuik, I found a specimen of what I took to be this fungus growing upon an oak stick, while in company with the Rev. John Stevenson. Unfortunately this specimen, which consisted of two or three cups, was lost—it fell out of the basket during the excursion—so that I was never able to be certain of its identity. At Exeter, however, several specimens were found upon birch and oak, by both Mr. Rea and myself. It is only in the young stage that the white tomentose exterior is visible. In the early stages it at first reminds one, as Fries indicates, of a Bulgaria or *Exidia recisa*. He goes further in suggesting Sowerby's figure of *Peziza radiculata*, t. 114. As the plant grows, it soon loses its cupulate or obconic form; flattening out, it becomes disc-shaped, but very soon convex. The upper surface is then thrown into folds, and the plant becomes what is often called *Tremella torta* Willd, although the true *T. torta* is a much smaller fungus. The evanescence of the white tomentum and the rapid loss of its cup-shaped form are the reasons this interesting fungus has been so long overlooked by us in Great Britain."—C.B.P.

RULES.

Society's name and objects.

1. The Society shall be called "The British Mycological Society" and its objects shall be the study of Mycology in all its branches, systematic, morphological and pathological, the publication of annual reports recording all recent discoveries in any branch of mycology, and more especially giving a brief synopsis of the work of European Mycologists and the recent additions to the British Fungus Flora.

Members of Society.

2. The Society shall consist of Foundation Members, Honorary Members and Ordinary Members, the number of Foundation Members shall be limited to 100 and that of Honorary Members to 20, but the number of Ordinary Members shall be unlimited.

Foundation Members.

3. Foundation Members shall consist of those Members and Clubs who joined the Society previous to the limit of 100 Members of the Society having been attained, but after this number has been attained no Person or Club shall be admitted as a Foundation Member.

Honorary Members.

4. Honorary Members shall be Ladies or Gentlemen of pre-eminence in Mycology, or who have rendered special service to the Society.

Ordinary Members.

5. Ordinary Members shall be Ladies or Gentlemen elected as hereinafter set out.

Election of Members.

6. Until the limit of 100 Foundation Members be reached any person or Club may signify their desire of joining the British Mycological Society and will

consequently be enrolled as Members thereof by the Secretary. Honorary Members shall only be elected at a meeting of The British Mycological Society by the majority of the Members then present. Ordinary Members shall be elected either by the majority of the Members then present at the annual meeting, or meetings, or by the President, Vice-President, Treasurer, and Hon. Secretary at other times. All Ordinary Members shall be proposed and seconded respectively by existing Members, who shall sign a certificate (see appendix) in recommendation of him or her, one at least of the proposers so certifying from personal knowledge, and every candidate for election shall sign an undertaking to abide by the Rules if elected (see appendix).

Yearly Subscription.

7. All Ordinary Members and Clubs shall pay an annual subscription of 10/- and Foundation Members 5/-, and the same shall be due by the First of January in each year, whilst Honorary Members shall be exempt from any annual subscription. Any Member wishing to retire from the Society shall give notice to the Hon. Secretary in writing before 1st of December of the previous year, otherwise he shall be liable for the annual subscription for the next year.

Government of the Society.

8. The management of the British Mycological Society shall be vested in the President, Vice-President, Treasurer, and Hon. Secretary.

Election of Officers.

9. The President, Vice-President, Treasurer, and Hon. Secretary shall be elected annually, at the first meeting of the British Mycological Society in each year, by a majority of the Members then present.

Meetings or Forays.

10. The British Mycological Society shall hold one or more meetings annually at a place and time determined by the Members at the previous meeting, or in default thereof, by the President, Vice-President, Treasurer, and Secretary. Invitations from Local Societies shall be first entertained and the acceptance of such shall imply that the Local Society undertakes to arrange the excursions of the foray,

obtain necessary permissions from landowners, and place at the disposal of the British Mycological Society a room, free of cost, for the exhibition of specimens, delivery of addresses, and the transaction of business.

Accounts to be annually furnished and vouched.

11. At the first meeting of the British Mycological Society in each year the Hon. Secretary shall produce an account of the receipts and disbursements for the previous year duly vouched by the Hon. Treasurer, or if the two offices be combined, then by an independent Member of the Society.

Payment of Expenses.

12. At each Meeting the Members then present must pay to the Hon. Secretary their share of the expenses incurred.

Election of Chairman in absence of President and Vice-President.

13. In the absence of the President and Vice-President, the Members present at any meeting shall elect a Chairman for that Meeting.

Rarities to be recorded.

14. Members finding rare specimens, or specimens new to the British Fungus Flora, are requested to immediately communicate the fact to the Hon. Secretary, together with full descriptions, the locality, habitat, and the date thereof, and the Hon. Secretary shall report the same at the next meeting of the Society.

Every Member to have a copy of these Rules and any alteration thereof.

15. A printed copy of these Rules shall be sent to every Member of the Society on election, and to all Members on their alteration.

APPENDIX.

Form of proposal for Ordinary Membership of the British Mycological Society.

_____

_____

*of*_____

_____

being desirous of becoming an Ordinary Member of the British Mycological Society, we, the undersigned Members of the Society, certify that we consider h to be a desirable Member of the Society, and beg to recommend h for election.

Dated this day of 19

_____(From personal knowledge).

_____

Certificate to be signed by the Candidate.

I hereby certify that I desire to become an Ordinary Member of the British Mycological Society and that I will abide by the Rules if elected.

_____

LIST OF FOUNDATION MEMBERS, 1901.

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23. Gibbs, Mr. Thomas, 43, St. Ronan's Road, Sheffield.
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26. Hughes, Mr. G. C., Rousham, Oxford.
27. Jenkin, Mr. Charles Frewen, 4, Vanburgh Park Road, West Blackheath.
28. Johnson, Professor T., D.Sc., Science and Art Museum, Kildare Street, Dublin.

29. Louth, The Antiquarian and Naturalists' Society, Louth.
30. Macfie, Mr. John William Scott, B.A., Rowton Hall, Chester.
31. Mackenzie, Mr. D., 12, James Watt Street, Glasgow.
32. Mason, Dr. Philip B., Trent House, Burton-on-Trent.
33. Montague, Mrs. A., Penton, Crediton, N. Devon.
34. Oliver, Professor F. W., M.A., D.Sc., Botany Laboratory, University College, Gower Street, London, W.C.
35. Paul, Rev. David, LL.D., 53, Fountainhall Street, Edinburgh.
36. Peacock, Dr. H. G., The Homestead, Monkton, Combe, near Bath.
37. Pim, Mr. Greenwood, M.A., Easton Lodge, Monkstown, Co. Dublin.
38. Pipe, Mr. Charles, Broad Street, Worcester.
39. Plowright, Mr. Charles B., M.D., King's Lynn.
40. Plowright, Mr. Charles Tertius Maclean, B.A., King's Lynn.
41. Potter, Professor M. C., M.A., Durham College of Science, Newcastle-upon-Tyne.
42. Ramsay, Mr. A., 4, Cowper Road, Acton, London.
43. Rea, Mr. Carleton, B.C.L., M.A., 34, Foregate Street, Worcester.
44. Rea, Mrs. Emma Amy, 34, Foregate Street, Worcester.
45. Robinson, Mr. J. B., St. Mary's Lane, Louth.
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54. Trail, Professor James W. H., M.D., F.R.S., The University, Aberdeen.
55. Wager, Mr. Harold, F.L.S., Arnold House, Bass Street, Derby.
56. Ward, Professor H. Marshall, D.Sc., F.R.S., F.L.S., &c., University Botanical Laboratory, Cambridge.
57. Watson, Dr., Deputy Surgeon General, University Club, Edinburgh.
58. Weiss, Professor F. E., Owen's College, Manchester.
59. White, Mr. J. Hill, F.R.H.S., 54, Broad Street, Worcester.
60. Woolhope, The Naturalists' Field Club, Hereford.

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President: H. Marshall Ward, D.Sc., F.R.S., &c., University Botanical Laboratory, Cambridge.

Hon. Secretary and Treasurer: Carleton Rea, B.C.L., M.A., 34, Foregate Street, Worcester.

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